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MARKETING OF HY320 - CANADA PRAIRIE SPRING WHEAT

- Brian A. Fedak

Good morning.

It's a pleasure to be with you today and talk about the marketing program for HY 320 wheat. Many of you are very familiar with this variety. You've grown it, processed it and handled it. I'm sure that by now, you have a pretty good idea how well HY 320 performs in the field.

I'm sure, you would also like to know just how well this new wheat will perform on the marketing side. I'm not going to say that we have all the answers to that. A lot of additional development work will need to be done as production of this wheat expands and additional markets have to be found. But we've been working very hard to find out as much as we can and I'd like to talk to you about the things we've done.

We started the program with the Canadian Grain Commission nearly three years ago. The objectives then were a little different than now. HY 320 wasn't licensed then and it was important that we get some idea about the saleability of this wheat before the variety was released to general production.

I'm sure you know the reason for this. HY 320 isn't just another new wheat variety. It has distinctive kernel characteristics and its milling and baking quality is different from that of any other class of wheat we've had up to now. A new class of wheat grades would, therefore, have to be established by the Grain Commission before HY 320 could be licensed. Such a step has an effect on the capacity of the grain handling system because HY 320 would have to be handled separately as it is moved forward into export position. This is why it was so important that we look at the market potential for this type of wheat before any final decisions were made on HY 320.

You, of course, know what's happened since. HY 320 has been licensed and a new class of wheat, called Canada Prairie Spring, was established by the Grain Commission last August. This doesn't mean that we believe this new class of wheat will have clear sailing on the export side. After all, this is a new type of wheat with some unique milling and baking characteristics. A lot more sales development work may, therefore, be needed if Western farmers produce large quantities of this wheat in the future.

But I'm getting ahead of myself. I want to talk about the marketing work that's been done so far. The program itself went through several stages. Much of the work was done by Grain Commission people. They have the laboratories and the technical expertise that's needed for this kind of program

The tests carried out in overseas markets were the most important part of this program. The main purpose here was to get the overseas customers to use HY 320, work with it and then find out how well it performed in their mills, bakeries and noodle plants. Five countries were selected for the tests. These were Mexico, Brazil, Egypt, Malaysia and Algeria. The countries represent a cross-section of the kinds of markets we think will be interested in this new wheat class. I'll discuss some of the results with you in a moment.

A secondary purpose in such tests, of course, is to introduce the new wheat to the customer so that he becomes familiar with its quality characteristics. This is important for a wheat such as HY 320 because it is different from other wheats grown in Canada, and I'm told, virtually anywhere else in the world. This is why HY 320 is sometimes called an anomaly. It mills like a softer wheat but has the gluten strength one would generally expect to get from a hard wheat. It is very important that the end-user know about these characteristics because it means adjustments in his milling or his baking processes may be necessary to make the best possible use of this wheat.

I would now like to discuss the milling and baking tests carried out in a number of the countries previously mentioned. Milling and baking specialists from the Grain Commission were present at each case to help with the tests and discuss results with the operators. There isn't time to give you all of the details, but I'll try and summarize the results as best as I can.

BRAZIL

Two tests were carried out in Brazil. The first, at Recife, involved a 90-tonne container shipment of HY 320 wheat, and the second, at Fortaleza, involved a commercial quantity of several thousand tonnes. Both cities are on the sea coast in the northern part of the country and mills here are familiar with our hard red springs and Glenlea.

The tests showed HY 320 wheat works well when used on its own and can be used in a blend with other harder wheats. The pao frances bread, which is a French-type of loaf, was of good size when baked with 100% HY 320 flour and, we were told, had good crust color and good crumb texture.

The millers in both locations told us they had no problems milling the grist of 100% HY 320 wheat. The bakers said their customers had not been able to tell the difference between the bread made from HY 320 flour and the bread they normally produced in their bakeries.

That's the positive side. There were also some negatives and these were pointed out very quickly. I mentioned earlier that HY 320 is a softer-type of wheat. This reduces the amount of moisture a miller can add during the tempering process and the amount of water the flour will absorb in the bakeries. Millers and bakers would like to have it the other way around. Water is cheap and the more water they can add the more money they will make. Whether we like it or not, this has a direct bearing on the relative price customers are prepared to pay for the wheat they buy.

EGYPT

Around 300 tonnes, bagged, of HY 320 was shipped to Alexandria for the tests in Egypt. The wheat was milled in two roller mills and one stone mill. All of the mills are owned by the government's South Alexandria Milling Company. It was milled at two extraction rates, 72% and 82%.

The 82% extraction flour was used to produce Balady bread in a large automatic bakery. Balady is something like the Pita bread that's made by some of the small bakeries in our Country. The 72% extraction flour was used to make Shami bread and Fino bread. Shami bread is a more sophisticated version of balady bread. It has the same shape as Balady, but is much whiter and has a different taste. Shami was introduced many years ago to use the aid shipments of flour Egypt receives from the U.S. Fino bread is a small French-type loaf of bread.

Now the results. As a general comment, the mills didn't have any trouble using the wheat. But the flour extraction rate was about 1 to 2% below what it should have been. The reason, it was found later, was that the wheat had been tempered to too high a moisture level. This happened because the miller had failed to recognize the softness of the wheat and had treated it as he would a harder wheat.

We also got some mixed results in the baking tests. In fact, the first day's results with the balady bread in the automatic bakery couldn't be described as anything but poor. This again happened because of the quality characteristics of HY 320. The Egyptians generally use flours with a weaker dough for their balady bread and mixing and fermentation times are, therefore, quite short.

The baking results changed quite dramatically on the second day once adjustments were made in the baking process to accommodate the gluten strength of HY 320 wheat. In fact, by the time that day was finished, we'd all concluded that the wheat would work very well for balady bread. This, plus the good results obtained with Shami and Fino bread, convinced the members of the Canadian team that HY 320 would work quite well in Egypt.

The Egyptians themselves, however, remained unconvinced. This became clear later when the Board's sales efforts didn't produce the results we'd been hoping for. It was then mutually agreed that a milling and baking specialist from Egypt would come to Canada to carry out further tests at the Grain Commission Institute in Winnipeg.

Those tests were completed in mid October 1985. The results this time around were more positive. Dr. Farouk El Bardainy, who conducted the tests, described HY 320 as a wheat with good milling quality. The flour, he said, was excellent for both Balady and Shami bread but not quite as good for Fino bread. His overall conclusion was, and I quote, that this wheat "would be an advantage to Egypt". We're hopefull the word will get back to Cairo where the purchasing decisions are made.

ALGERIA

This is the latest full-scale test that's been carried out with HY 320 wheat. Ninety tonnes of wheat were used. The mill was very new - only three years old - and the impression of the Canadians was that the staff was well trained and very qualified. The wheat was tempered (very carefully) to a moisture level of 15% and milled at an extraction rate of over 79%.

The flour was sent to a large government-owned bakery south of Algiers and smaller parcels were sent to two private bakeries. It was used to make French-style baguettes, the main bread used in the urban areas of Algeria, and a smaller quantity of croissants.

The results were discussed at length with the Algerians. There isn't time to go into all the details. I'll just summarize the two main conclusions reached by the Canadian team.

1. All of the bakers were positive to very positive as to the suitability of the HY 320 flour for both baguettes and croissants. It was particularly noted that the bakers were able to get good to excellent results the first time they used this new flour.

2. HY 320 wheat does not present any problems to the miller provided it is tempered to the right moisture level. The flour color was bright and the ash content, even at the high extraction rate, was acceptable.

That gives you an idea as to the kind of tests and development programs that have been carried out with HY 320 wheat. Other programs, of a somewhat different kind, will be carried out in future months.

Given the results I've described so far, one could easily come to the conclusion that this is a very marketable wheat. But, as I said at the outset, HY 320, or CPS as well now call it, isn't going to have clear sailing in the export market. We're into a dog-fight with other wheat exporting countries. We're beginning to see the price effects of the US BICEP program. We've seen the Austalians down-grading their milling wheat and selling it as feed well below the corn price. It is not the best time to begin marketing an HY 320-type of wheat. We're convinced we can do it. But the real point is whether it can be sold at a price that makes sense to farmers.

Thank you.

PERFORMANCE OF DWARF CORN AND SUNFLOWER IN MANITOBA

Dwarf corn has several advantages over conventional corn in Manitoba. One of the advantages is standability. There are several reasons for this, one being the inherent shortness of the dwarf corn plant. On the average, a dwarf corn plant is 50 - 60 cm. shorter in stature than conventional corn. This, coupled with the fact of smaller ears and lower ear placement on the plant means less stress on the stalk under adverse conditions.

The root system of the dwarf hybrids presently under test in Manitoba seems to be equal to, or more developed than conventional corn root systems, hence providing an even better support for a shorter plant. There is reason to believe that a better root system indicates some drought tolerance as well, but this has not really been tested to date.

Another benefit of growing dwarf corn would be the additional yield potential that it has. As can be seen in Table 1, yields in 1984 were 19% higher than the check average over 3 locations. As you can well imagine, 1985 yields were a little more difficult to obtain. This data is also included on Table 1, with yields from Morden and Brandon, compared to two conventional hybrid checks. The dwarf experimental came through with a 54% yield advantage over the two listed varieties.

Can the dwarf perform similarly under field scale conditions? This was the question often being asked of PAG's research and marketing staff. Hence, in 1985 approximately 75 field scale dwarf plots were planted across Canada with about 26 plots in Manitoba. Plots ranged in size from .4ha. to 2 ha. The purpose of the plots was to evaluate planting and harvesting methods, as well as yield potential. Unfortunately, with the extreme lack of heat units for Manitoba corn, the dwarf plots suffered many of the same consequences as did conventional corn. Harvests taken by tandem disc or other items of tillage equipment are difficult to measure for yield.

We did, however, manage to harvest a few plots, and one particular plot had a conventional check hybrid planted beside it. This plot was located a few km south of Jordan and the dwarf corn showed a 50% yield advantage coming in at 4.14t/ha compared to PAG SX104 at 2.76t/ha.

A few of the other plots were harvested for grain, however, extremely high moisture content and poor quality, similar to conventional grain corn proved to make yield measurement difficult.

As mentioned earlier, one of the motives behind field scale testing was to determine the feasibility of using cereal grain equipment for the seeding, maintenance and harvesting of dwarf corn. Again due to the climate problems experienced, Manitoba data is limited, particularly harvest information.

Planting experiences were positive, with press drills, air seeders, and hoe drills providing good emergence results. A discer seeder was used in one location, but depth control was a problem and that plot was not successful. Press drills and air seeders worked extremely well, and there were few problems encountered with adjustment for population. The general target for population density was 110,000 - 123,000 plants/ha with an expected final stand of 10% less than planted. Most plots fell nicely into this range.

Emergence tended to be somewhat uneven and clumped, due to unevenness in the seed being fed out of the feed rolls. We feel this could possibly be corrected with a slightly faster ground speed. Even so, the uneveness did not seem to be a problem and in fact was not noticeable after the dwarf reached 60 cm in height.

All of the plots were planted after May 14, and even though the dwarf corn has excellent seedling vigour, the majority of the plots did not mature for grain. With the excellent cold vigor that was observed, earlier planting is certainly feasible for next years testing.

Fertilizer was applied as a pre-plant broadcast in most cases, with a starter mix sidebanded at time of seeding. Weed control was generally pre-plant incorporation or pre-emerged application, although there were a few cases of post emergent application to control escapes. The cool spring weather made for poor chemical weed control in a number of other crops and in some cases, the weed control in the dwarf wasn't much better. In general, weed control was satisfactory.

Harvesting the short statured corn has been an interesting experience. The high population and narrow rows make conventional corn equipment unworkable and conventional cereal harvest equipment has been used, specifically a straight cut header attachment.

Certain adjustments on the machine are required. The table auger must be adjusted to allow for the passage of all the plant material and the reel bats must be set just ahead of the cutter bar. Tine type reels don't work as well as conventional bat type reels. The tines seem to knock ears off the stalk as the combine can't always digest the material as quickly as the reel wants to feed it in. Average ground speed was anywhere from 2.5-3.5km/h.

An interesting concept was tried for silage harvesting in Ontario. A conventional self-propelled swather was used to cut and windrow the corn. The harvester followed behind and picked up the windrow with excellent results. The swather travelled between 6 - 9 km/h and the harvester came and picked up the complete windrow with no difficulty or loss.

This concept was tried on the previously mentioned grain test south of Jordan, with a combine instead of the sileage harvester. Results were excellent, with no harvest losses to speak of. Unfortunately, the Ontario harvest was complete, so the technique wasn't evaluated further. The remainder of the Manitoba plots that were harvested were done with the straight cut header.

No doubt one could see the merits of using a swather and pick-up to harvest the dwarf corn, but it would have to be a simultaneous operation. Windrowing and then leaving the corn in the windrow to dry could present serious difficulties if wet weather set in. There isn't enough stubble left to really hold the windrow off the ground for any length of time, and to dry the ears under the windrow could be problematic. There does seem to be some potential to harvest by windrower and combine, however.

Grower interest in the dwarf experiments has not abated even with the devestating corn performance across the province this year. PAG Seeds will continue to work with growers in Manitoba to make the growing of dwarf corn a viable alternative to other crops.

Dwarf sunflowers have been tested in Manitoba for three years including 1985. The first years testing took place in two field scale test plots against conventional hybrids, one on my own farm at Elm Creek, the other at St. Anne. Presently, PAG Seeds has two dwarf hybrids in licensing trials with the Manitoba Sunflower Committee, and they are each in the second year of testing with a possibility of recommendation for licensing support this spring.

As in dwarf corn, standability is an obvious atribute of dwarf sunflowers. Yield potential and disease resistance is comparable or better than conventional hybrids currently licensed, but oil content is somewhat less than average.

Conversly to dwarf corn practices, reduced height sunflowers are not planted in narrow rows, nor is it necessary to increase plant population to increase yields. Dwarf sunflowers are planted in populations ranging from 49,000 - 74,000 plants/ha. Because of the short stature of the dwarf sunflower, the standability rating is better than conventional taller hybrids.(Table 2) Average height of a dwarf hybrid is 20 - 30 cm less than hybrids presently being grown.

Oil content, as noted on the chart, is somewhat lower than the average. With the stronger standability factor, higher populations can be planted without fear of lodging problems, and oil content can be raised as much as 2%.

Yield potential, as seen on Table 2, is excellent. The dwarfs are both single cross hybrids and are very uniform in height, flowering and maturity. High yields, as seen here, are also the norm on field scale tests. A number of growers had planted a few hectares of these hybrids in 1985 and all reports to date have been positive.

It would seem with the here to fore mentioned attributes and data presented, that dwarf sunflower hybrids have a place in Manitoba cropping alternatives. It is our wish at PAG Seeds to continue to expand and develop these alternatives for the Manitoba farmer.

Thank you

Terry Janzen

TABLE 1

1984 Licensing Trial Manitoba 3 Locations

Hybrid	Yield (t/ha)	Moisture %
391134 R	4.39	33.2
Pioneer 3994	3.91	28.7
Pioneer 3995	3.76	26.2
Pride R090	3.43	29.0

1985 Licensing Trial Manitoba 2 Locations

Hybrid	Yield (t/ha)	Moisture %
391134 R	2.81	51.2
Pioneer 3994	1.74	55.4
Pioneer 3995	1.91	45.4

TABLE 2

1984 Licensing Trial Manitoba 6 Locations

Hybrid	Yield(kg/ha)	Oil %	Height(cm)
894	2406	45.6	147
204	2245	44.7	151
7101	2365	45.5	150
100	2519	41.9	122
208	2506	42.3	124

1985 Licensing Trial Manitoba 5 Locations

Hybrid	Yield(kg/ha)	Oil % (Holland) (Only)	Stlk Brkg % (Morden Only)
894	1622	43.7	72
204	1642	43.5	89
7101	1645	45.8	53
100	2046	41.8	0
208	1985	40.1	3

STATUS OF HYBRID CANOLA DEVELOPMENT IN CANADA

David Holman
Continental Grain Company

December 11,1985

INTRODUCTION

In reviewing this topic, it is relevant to briefly consider the early history of rapeseed in Canada.

Canola varieties grown in Canada belong to either the Brassica Napus or Brassica Campestris species which in turn belong to the much larger (cruciferae family) mustard family. Brassica Campestris is know as "Polish Type" canola/rapeseed in Canada, and as turnip rapeseed in Europe. Brassica Napus is known as "Argentine Type" canola/rapeseed in Canada, and as rape or suede rapeseed in Europe.

History suggests that rapeseed was cultivated as early as the 20th century BC in India, and was introduced in China and Japan about the time of Christ. The need for Canadian rapeseed production arose from the critical shortage of rapeseed oil that followed the World War II blockade of European and Asian sources of rapeseed oil in the early 1940's. The oil was urgently needed as a lubricant for the rapidly increasing number of marine engines in Naval and Merchant ships.

In 1943, 19000 kgs of Brassica Napus seed was purchased from U.S. seed companies. This seed had originally been received from Argentina, hence the unoffical term Argentine type. In 1936, a Saskatchewan farmer obtained some rapeseed from a friend or relative in Poland. He grew this seed for a few years and found the species well adapted.With the coming of the war, and the release of information about the need for rapeseed production, the farmer increased his seed supply and sold seed to his neighbours. Because of the Polish origin of both the farmer and the seed, the species, which was identified as B. Campestris, became known as "Polish Rapeseed".

With the advent of hybrid canola, history is, in some ways repeating itself. This is because most of the current genetic systems being used for the hybridization of canola, have come from overseas; in particular the Far East. It is anticipated that in the short to medium term, the Polima system from China will be the most successful genetic system.

This paper will examine the who, what, why, when and how of hybrid canola development in Canada.

2. WHO IS INVOLVED AND WHAT ARE THEY DOING?

There are a number of organizations currently involved in hybrid canola research in Canada.

a) ALLELIX - UNITED GRAIN GROWERS JOINT VENTURE

Allelix and UGG formalized a partnership in 1985 to develop, produce and distribute hybrid canola. Allelix is using traditional plant breeding techniques plus some Bio-Technology to develop the necessary germplasm. UGG will handle the field testing, mass seed production and marketing of the product once it is released. The joint venture is being assisted by a government grant from the National Research Council. The partnership fieldtested some of their products in Manitoba and Saskatchewan this summer.

b) CONTINENTAL GRAIN COMPANY

Continental Grain, through one of its six International Seed companies, has been involved with hybrid canola development for a number of years. The work has been primarily conducted by Pacific Seeds in Australia, but field testing of the hybrids, and pilot seed production began in Canada this summer. It is expected that the company will accelerate its seed activities in canola. The company has been developing seed production techniques for hybrid canola in Australia for the last 2 years.

c) BIOTECHNICA CANADA

Biotechnica Canada is jointly funded by Biotechnical International of Cambridge (USA) and Vencap (a venture capital firm in Alberta). BTC's only commitment at the moment is to a canola project where they intend to invest $12 million to develop a canola breeding/biotechnology program to develop canolas with herbicide tolerance. The company is only a few months old, and has not yet commenced their project.

d) PALADIN HYBRIDS

A new company has been formed in Ontario, being a joint venture between Oseco and Pioneer Grain. This new venture will participate in canola research with the intention to perform traditional plant breeding, and to use cell and anther culture in their biotechnology program. In addition, a nuclear genome approach will be made in an attempt to understand and control the nuclear basis for male sterility. The company is also receiving a financial grant from the National Research Council.

e) AGRICULTURE CANADA - SASKATOON RESEARCH STATION

This program has a slightly different approach. It is evaluating several hybrid systems in the 3 species of B. Napus, B. Campestris and B. Juncea. Most other programs are concentrating on B. Napus. It should be recognized that the hybrid program is only one of a number of breeding objectives that the station is involved with.

f) UNIVERSITY OF MANITOBA

The university has an advanced hybrid breeding program, and has been testing both hybrids and seed production at a field plot level. The hybrid program is only one of a number of breeding objectives that the University has. Their canola breeding program has a broad resource base that includes oil quality aspects, plant pathology and cytogenetics.

g) UNIVERSITY OF GUELPH

The university has ongoing projects with both Allelix, and King Grain Ltd. The projects are using a variety of Biotechnology techniques to develop new hybrid varieties.

3. WHY CANOLA HYBRIDS?

Hybridization of a crop is one of the quickest ways of improving overall performance. Canola hybrids will offer the following advantages:

a) YIELD INCREASES

Research conducted in Canada has shown that yield advantages of up to 43% are possible in hand crossed hybrid canola. It is most likely, however, that the initial hybrids released may show yield responses of 20% to 25% over existing varieties. Over a period of time, these yield responses will improve as superior hybrids are developed. A study of the attached graph (Figure 1) will show the spectacular progress that has been achieved in Australia with successive sunflower hybrids. These hybrids have been developed by Pacific Seeds, one of Continental Grain's Seed companies. It is this company that has developed hybrid canola for Continental Grain. It is most likely that hybrid canolas will show the same yield trends as hybrid sunflowers.

b) MATURITY

A combination of a wide range of genetic resources through hybridization will allow different maturing hybrids to be developed. Consequently, it will be possible to have a hybrid for the Peace River, and a different hybrid for the Southern Manitoba area. The ability to select a quick maturing hybrid without sacrificing yield will be of tremendous advantage to the Canadian farmer faced with a short growing season.

c) DISEASE RESISTANCE

It is unlikely that the initial hybrids released will exhibit substantial disease resistance (e.g. Sclerotinia, Black Leg). However, as evidenced in both the hybrid sunflower and hybrid corn industries, disease resistance will soon follow as breeding programs become more diversified and genetic resources pooled.

d) OIL QUALITY

Aspects of oil quality and quantity can be more easily selected and bred for in a hybrid breeding program.

e) UNIFORMITY AND IMPROVED PLANT TYPES

While these aspects are not as critical as yield increases and disease resistance, they are features which plant breeders are constantly selecting for. A uniform crop presents less problems at harvest, and a good looking field is always the pride and joy of any farmer.

4. WHEN WILL CANADA SEE HYBRID CANOLA COMMERCIALY AVAILABLE

The commercial availability of Hybrid Canola in Canada will depend on three factors:

a) ECONOMIC ADVANTAGES OF HYBRIDS

Hybrid seed will undoubtedly cost more than existing open-pollinated varieties. Costs of producing the seed are very high, seed companies have millions of dollars invested in research and development and ongoing research is expensive. That extra on-farm cost must be justified by yield increases. If hybrids can deliver 20% more yield, there is little doubt that they will indeed pay their way on the farm. Some breeders are confident hybrid canola can outyield conventional varieties by 20% to 30%.

While field trials in Canada and Australia have shown that yield responses of that order are highly likely, more extensive trialling is required to confirm these figures.

b) ABILITY TO PRODUCE SEED OF A HIGH QUALITY

The ability to produce Hybrid Canola seed of a high genetic purity at an economical price is a major factor to be considered before commercial release. Handcrossing is not an economical way to mass produce hybrid seed, and the structure of the plant preludes the field-scale prevention of self-pollination, by relatively simple mechanical means (e.g. detasseling corn). Most of the current work is focusing on cytoplasmic male sterility (CMS).

CMS plants cannot produce pollen. Consequently the F1 hybrid seed is produced when specially selected pollen producing parent lines, capable of restoring pollen production in the progeny of CMS plants, are used to fertilize the CMS plants. This system of seed production has necessitated the development of new technology for effective hybrid canola seed production. Pollinating insects are needed to transfer the pollen from the pollen producers to the CMS females.

In addition, some of the current CMS systems being used are not perfect, and small quantities of pollen are sometimes produced. If self pollination occurs, the resulting seed will become a contaminant in the hybrid seed.

Extensive research in seed production techniques is currently being conducted in both Australia and Canada. It is expected that positive results will come from this research, and that production of seed of a high genetic quality will be achieved.

c) REGISTRATION OF HYBRID CANOLA

A variety must be evaluated in the co-operative trials for a 3 years before getting a license. The triazine-tolerant variety triton, however, was licensed after only 2 years in the co-op trials. This precedent may allow hybrids to be registered after 2 years in the licensing system, if their performance is substantially better than existing varieties.

The commercial release date will therefore be determined by the commencement date of a hybrid in the licensing system. The most optimistic scenario could see hybrids in the co-operative trials in 1986 and 1987, with registration in 1988. More conservative industry officials have named 1990 as the most optimistic release date.

5. HOW WILL CANOLA HYBRIDS FIT INTO THE CANADIAN CANOLA INDUSTRY?

The advent of canola hybrids will be an exciting time for the canola industry. It is likely that the canola industry will follow the same route as the hybrid sunflower industry - hybrid sunflowers were only introduced into the U.S.A. and Australia about 10 years ago. The industry in those countries now uses hybrids exclusively.

There is a great deal of work to be done over the next few years to ensure that the introduction of hybrid canola is a smooth and effective process.

a) Seed Production Systems. The western Canadian seed growers will need to accept their changing role as contract growers for private seed companies. Private hybrid seed companies are new to Western Canada, and their activities must be as least disruptive to existing seed production systems as possible.

b) Price. Hybrid canola seed will be more expensive than open-pollinated varieties. This price, however, must be set at a realistic level, to ensure that both the seed companies and the farmers are able to generate positive returns on their investment.

c) Farmer Education. Farmers will need to be educated on aspects of hybrid seed usage. There may be some initial resistance to its use, but when it is shown that the benefits outweight the costs, the product will be accepted by young and old.

d) Distribution. Effective distribution systems have to be established. These systems must ensure that the interests of the farmer are adequately serviced in such areas as quality control and and extension agronomy.

6. CONCLUSION

The Canadian Hybrid Canola seed industry will be an exciting and challenging industry to be involved in. The market is large, and the potential regards for both farmers and seed companies are high. This industry is a complex one, and its introduction to Western Canada must be handled professionally and carefully. It will be important over the next few years for agriculturists to work together with the seed companies - to share experiences, to listen to each others advice, and to work toward the common goal of improving the canola industry for this great country.

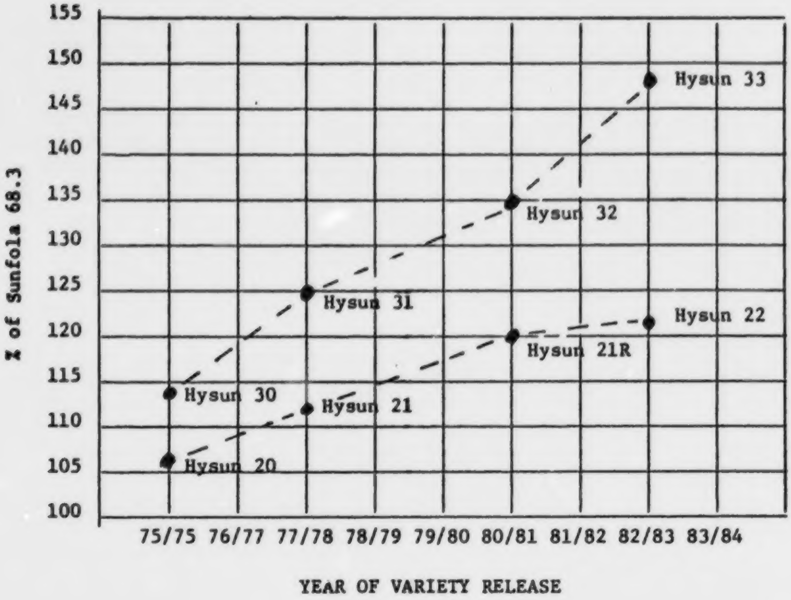

FIGURE I PACIFIC SEEDS SUNFLOWER HYBRIDS - YIELD TRENDS

PERFORMANCE OF TRIAZINE TOLERANT CANOLA VARIETIES AND MARKETING ASPECTS

DAVE WATSON
CSP FOODS LTD., ALTONA, MB.

Triazine Tolerant Canola (T.T.C.) is a relatively new crop in Canada. Originally, Dr. Wally Beversdorf, at the Ontario Agricultural College at Guelph, was in search of an alternate crop to grow in rotation with corn. Many acres of land had been treated with atrazine leaving corn as the only crop able to be grown.

The origin of the tolerance to the triazine chemicals came from a wild turnip rapeseed found growing in corn fields treated with atrazine. This tolerance was bred into existing canola varieties. In 1982, triazine tolerant canola lines form Dr.Beversdorf's programme, were tested in Saskatchewan. These tests sparked great interest from canola producers looking for a way to control wild mustard and stinkweed in their canola crops. A number of meetings were held and it was agreed that a six line strain of triazine tolerant canola known as ATR5 - Tower would be contracted and test crushed in the fall of 1983. The crusher would be CSP Foods Ltd.

CSP Foods has been contracting triazine tolerant canola for three years. The first year with the six line strain and the past two with OAC Triton. During this time we have observed some of the advantages and disadvantages of triazine tolerant canola both agronomically and from a crushers point of view.

The number of hectares of T.T.C. in Western Canada has increased over the past three years. In 1983 there were 640 ha, in 1984, 6600 ha, and in 1985 there were approximately 65,000 ha sown in Western Canada. 1985 was the first year that OAC Triton was available to all canola producers.

Although CSP Foods has contracted T.T.C. in both Manitoba and Saskatchewan, most of the information presented will be from Manitoba only, and on the variety OAC Triton. Agrnomically OAC Triton lacks seedling vigor when compared to other canola varieties. This can lead to problems when any type of stress is present. Seedling diseases, flea beetles or weed pressure could cause major yield losses with the reduced vigor. Therefore preparation of a firm seed-bed to allow for quick and even emergence should be considered a necessity. As well pre-emergent flea beetles protection should be considered a must. Some seed treatments do give protection for both flea beetles as well as some seedling diseases. These dual protectants would be a good investment for OAC Triton.

For weed control, some of the chemicals are used as a pre-emergent. However, if a post-emergent is used to control the weeds, spray early to reduce the stress of competition on the crop.

According to the Manitoba Crop Recommendations, OAC Triton matures four days later than Westar. From producer comments we received, the range was from no difference to up to 10 days later. In 1985 the longer time to maturity was an important factor. Most OAC Triton that had to be reseeded after the June dust storm, did not mature before the frost.

Yield potential for OAC Triton is lower than other canola varieties. The Manitoba Crop Recommendations shows OAC Triton yielding 63% of Westar. This large of a difference has not been noted by CSP Foods. On average, in 1984 our OAC Triton yield was 1037 kg/ha which was 84% of the Westar yield. In 1985 the average yield was 1463 kg/ha which was 81% of the yield of Westar. Although the difference is not as large as in the test plots, it is still large enough that producers must give serious thought before planting Triton.

When the OAC Triton was crushed, there were no problems with the actual processing of the seed. However, there were two quality concerns which arose. OAC Triton has a 2-3% lower oil content when compared to other canola varieties. From lab tests and from the results from test crushes this difference has shown every year. The other concern is the chlorophyll level in the oil. The oil produced from OAC Triton has higher chlorophyll levels than other canola varieties. The chlorophyll levels were approximately 29-30p.p.m. where as the Westar chlorophyll level was approximately 18-20 p.p.m. The higher chlorophyll levels lead to higher refining and bleaching costs.

There has been a new triazine tolerant canola which has been supported for licensing by the name Tribute. Tribute is two to three days earlier than OAC Triton and shows a chlorophyll level similar to Westar. Unfortunately, oil content and yield are similar to OAC Triton. Tribute is also susceptible to lodging similar to Altex or Andor. Planting seed for Tribute will be in limited supply for 1986 with 1987 being the first year any amount of seed will be available.

Although there appears to be many negative attributes for T.T.C., it does have some positive aspects. In Manitoba, T.T.C. allows corn growers to produce an alternate crop on land previously treated with atrazine. For producers having fields polluted with cruciferous weed or other broadleaf weeds normally hard to kill in canola, T.T.C. is an option. Triazine tolerant canola gives a producer the option of producing a canola crop in situations where canola was not previously an option.

There is concern in the canola industry regarding the marketing of T.T.C. The lower oil content of T.T.C. makes a significant difference in the return per tonne crushed whether it be crushed domestically or exported. The higher chlorophyll level of OAC Triton increases the cost of upgrading the oil. These two factors are the major concerns regarding triazine tolerant canola. Tribute, although the chlorophyll level is lower, still has an oil content similar to OAC Triton.

Before triazine tolerant canola can be readily accepted by the total canola industry it must have the yield potential and the seed quality which at least equals those of the non-triazine canolas. Until a T.T.C. variety which equals the non-triazine canolas is developed, producers should only consider growing triazine tolerant canola after ruling out growing a conventional canola variety.

EL-107 PREPLANT INCORPORATED FOR WILD MUSTARD CONTROL IN SUNFLOWERS AND PULSE CROPS

Wild mustard and winter annuals continue to be a problem in sunflowers and pulse crops. Isoxaben (EL-107) is being developed by Elanco to control these weeds, not only in sunflowers and pulse crops, but also in cereals and corn. Sunflowers and pulse crops show tolerance of up to 200 g ai/ha of isoxaben applied PPI. Wild mustard and stinkweed are controlled by 100 g ai/ha of isoxaben applied PPI. Spring and fall applications appear equally effective. Isoxaben may easily be tank-mixed with other soil incorporated herbicides including dinitroanilines for broad-spectrum weed control.

Isoxaben is a relatively persistent compound, showing immobility in soil. Canola and flax are sensitive to isoxaben, and initial data show a two year rotational restriction with these crops will be necessary.

Research will concentrate on further confirmation of efficacy and crop tolerance, not only in sunflowers and pulse crops but also in cereals and corn. Rotational crop and soil persistence issues will be addressed.

PRESENTATION TO THE MANITOBA AGRONOMISTS' CONFERENCE, UNIVERSITY OF MANITOBA

We, of Rock Lake Oil Seeds Ltd., are pleased to have the opportunity to make this presentation in regard to a proposed Flax Seed Crushing Facility to this Agronomists' Conference.

The site location for this plant will be midway between Pilot Mound and Crystal City in the R. M. of Louise on P.T.H. # 3 as well as on CP Rail right-of-way in the La Riviere-Napinka Subdivision.

In the last three years, a group of local flax producers and businessmen have invested considerable time and money in appraising the economic feasibility of such a project.

As a result of several feasibility studies, this group has concluded there is economic rationale for the construction of an expeller plant at this location.

The proposed site locates the plant in the middle of Canada's largest flax growing area. Over 50 percent of Canada's flax is produced in Manitoba and, of this total, 62 percent is grown within 50 miles of the plant site. The proposed plant will have access to over three times its annual crush requirements, assuring supply and reducing procurement costs.

Canada is second only to Argentina as a world flaxseed producer. While Canada produces 23 percent of the world's flaxseed, it accounts for nearly 80 percent of the world's total trade. The majority of Canada's flaxseed is exported, taking with it potential Canadian jobs.

The proposed plant would deflect some flaxseed from the traditional export route, directing it instead to secondary processing. Two value-added products- linseed oil and linseed cake- would be produced. The facility is proposed to crush 70,000 tonnes of flaxseed annually. This represents 10 to 15 percent of Canada's annual production and 16 percent of the country's flax exports.

The expeller process produces a premium product not available from the more common solvent extraction process. Linseed cake, which is the by-product of the expeller process, contains 5 percent oil. By comparison, the by-product of a solvent extraction process, linseed meal, contains only 0.5 percent oil. The oil content of expeller cake allows it to command a premium price. It is in high demand in Europe where its price is comparable to soya meal despite the fact it contains only 75 percent of the protein.

A Canadian produced linseed cake also offers the opportunity to develop a North American specialty market. It is anticipated that a Canadian produced linseed cake could stimulate demand from horse enthusiasts and veal feeders. The linseed oil produced by this extraction method is deemed to be a premium product in world markets.

Processing in Canada will be competitive internationally because of lower energy costs and comparable labor costs. As well, Canadian flaxseed is of superior quality to that of most other countries due to characteristics developed in Canada's colder growing season.

Due to the potential of the specialty market, interest from Europeans, and the additional cost and limitations of solvent extraction equipment, the Rock Lake group is committed to an expeller flaxseed processing facility. Economic studies back their decision to focus on this production method because of its greater efficiency of processing.

The initiative of the Rock Lake farmers and businessmen, which resulted in government financial support, has attracted foreign interest in the project. While researching the possibility of building a plant, we discovered a group of Europeans would be interested in contributing to a flaxseed crushing plant which would allow them to market the products in Europe.

The success of this agricultural product processing facility will largely depend on the marketing and transportation of the processed products. We felt, and were assured that we had a good European market, but took a more business-like approach and a group of 3 men travelled to Europe in the fall of 1984 to verify markets. After many hours and much travel in and around the linseed oil trade in Europe, the committee was able to report markets for both linseed oil and expeller cake were of a very positive nature, providing that we use the expeller method of processing and guarantee continuity of supply.

This European group will provide $3 million or about 25 percent of the construction and start-up costs. The involvement of the Europeans in the plant is in keeping with the need to stimulate the Canadian economy through capital investment in manufacturing and processing facilities here in Manitoba.

However, to ensure the ongoing success of the plant, the support of flax growers and investors is essential. One-quarter of the plant's construction costs are slated to be raised through share subscriptions.

The proposed flaxseed plant costing $12 million will be capable of crushing 70,000 tonnes of flax annually, producing some 26,000 tonnes of high quality linseed oil and 42,000 tonnes of premium linseed cake.

The group of farmers and businessmen which has been working to make the plant a reality has assembled financial support from 3 sources. The federal government, through the Western Transportation Industrial Development Program, is prepared to contribute 25% of the capital costs or $3 million. The Province of Manitoba, through the Manitoba Jobs Fund, will provide up to $2,250,000. loan guarantee support to the company against the future delivery obligations for equity purchases by producers. Finally, the group has elicited a commitment from the Europeans for a $3 million equity investment to acquire a 50% share in the plant.

This equity plus $750,000. in cash share purchases and a $3 million mortgage on the $12 million facility would raise the necessary capital.

The final success or failure of the venture, however, rests with the producers and investors in terms of their support through equity participation in the corporation. Without this commitment from area producers and investors, the plant cannot proceed.

A prospectus for a public offering of shares for Rock Lake Oil Seeds has been filed with the Manitoba Securities Commission to raise $3 million and is now available. This is to be accomplished through the sale of 40,000 Class "A" or Class "B" shares at $75.00 per share. Successful placement of 30,000 of these shares by March 1, 1986 will enable the project to proceed.

MP Jack Murta (PC-Lisgar) said the spinoff benefits from construction could provide an extra $60 million to the southern Manitoba economy.

Murta also states that the plant also spreads out food processing operations in southern Manitoba, which are concentrated in the Carman-Winkler-Altona area.

We thank the Agronomists' Conference for this opportunity to speak on what we consider is a very worthwhile and much needed project in the Province of Manitoba. Thank you.

NEW INFORMATION ON BLADDER CAMPION CONTROL

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Bladder campion (Silene cucurbalis) is a persistent, deep-rooted perennial weed which is currently of concern in Southeastern Manitoba and in the Dauphin area. The weed has recently been found in the Gimli area at one site. The plant can be recognized by its leathery, dull-green leaves and by its white, inflated-capsular flowers. (A complete description of the plant can be found in the Manitoba Agriculture Factsheet "How to Control Bladder Campion").

Economic Costs

Little work has been done to establish what effect bladder campion has on crop yields. The weed appears to do poorly under annual cropping systems, but thrives in hayfields. In hayfields or pastures, bladder campion infestations may worsen if the hay stand is unthrifty.

Bladder campion seed is of similar size and shape to that of alfalfa seed. For this reason, the seed is difficult to separate from the alfalfa seed during cleaning. To date, the weed has not been found in pedigreed alfalfa seed in the province but has been found present in some samples of common seed harvested from infested fields.

Control

Recommendations for control previously relied on an intensive-summerfallow approach to reducing field-wide infestations - a practice of limited use in the erosion-prone, lighter soils where bladder campion thrives. Recommendations for control of patches relied on the use of a residual herbicide, namely Tordon 22K. Applications of Tordon 22K however, preclude the growth of most broadleaf crops for years to come on treated soil.

During the 1984 and 1985 growing seasons, experiments were established to determine if more alternatives could be found for bladder campion control. The experiments had three objectives:

1) To determine if dormant-applied herbicides applied in alfalfa fields are effective in controlling bladder campion.
2) To evaluate the control achieved with herbicides applied immediately after the first cut of hay had been removed from infested areas.
3) To assess the effectiveness of crop rotation in reducing bladder campion populations.

Results

1. Dormant-applied herbicides for bladder campion control in alfalfa.

Treatments were applied in late fall after alfalfa had gone dormant, or in early spring, prior to alfalfa breaking dormancy, at two sites in Southeastern Manitoba. The treatments were applied using a CO_2-pressurized bicycle sprayer and were evaluated for bladder campion control and for crop tolerance in the following summer. Results appear in Table 1. Trials at both sites indicate that Velpar (hexazinone), Lexone (metribuzin), Princep Nine-T (simazine) and Sinbar (terbacil) were ineffective in controlling bladder campion. Glean (chlorsulfuron) gave acceptable control of bladder campion.

2. Post-cut treatments for bladder campion control in alfalfa-hay fields.

Treatments were applied to an infested field in mid-summer of 1985, 2 days after the first cut of hay had been removed from the field. The treatments were applied using a CO_2-pressurized bicycle sprayer and were evaluated for control 4 weeks later. Results appear in Table 2. Poor control and poor crop tolerance was noted with Lexone. Poor control was also noted with applications of Harmony (a chlorsulfuron analog). Excellent bladder campion control was achieved with application of DPX L5300 (also a chlorsulfuron analog). This product caused severe injury to alfalfa.

3. Effects of crop competition on bladder campion populations.

A hay field which was heavily infested with bladder campion was ploughed during the fall of 1984. The field was fertilized and seeded to a barley crop during the spring of 1985. Strips of barley were removed immediately after emergence, using Fusilade (fluazifop). Bladder campion populations emerging from cropped versus crop-free strips were clipped, weighed and compared.

Bladder campion plants growing within the cropped areas were suppressed by approximately 65%. Plants in both cropped and noncropped strips did not reach flowering by harvest. Infestation bordering the ploughed field flowered by mid-July.

Conclusions

The most sound recommendation for reducing field-wide infestations of bladder campion would be the use of a combination of tillage and annual cropping. Barley provides excellent suppression of the weed. Use of this crop or of wheat would enable producers to utilize Lexone (metribuzin) for control of newly germinating bladder campion seedlings. Other trials indicate that this treatment will provide excellent control of seedlings up to the 6 leaf stage. (It will not however, control plants emerging from rootstocks). It is likely that the use of annual crops may be necessary for more than one year in order to reduce bladder campion populations to the point where the field could be returned to perennial forage production.

Herbicidal control of established bladder campion within hay fields remains a problem. Although Glean provides good control of bladder campion, the product leaves a long lasting soil residue. This residue will kill newly-germinating broadleaf crops (including alfalfa) for a number of years. Further work is necessary to determine if shorter-residual analogs of Glean may provide a practical alternative for in-crop control of bladder campion.

Table 1 - Dormant-applied chemicals for bladder campion control.

Treatment	Rate (kg/ha)	Crop Injury		Weed Control	
		E	SJ	E	SJ
Sencor	1.0	8.3	7.0	6.3	7.0
Sencor	2.0	6.0	7.3	6.7	7.0
Velpar	1.0	9.0	7.0	5.0	8.0
Velpar	2.0	9.0	7.8	6.3	8.0
Glean	0.023	9.0	6.7	9.0	9.0
Sinbar	0.7	9.0	5.0	0.0	0.0
Princep	0.75	9.0	-	0.0	-
Unsprayed	-	9.0	9.0	0.0	0.0

E= Elma (spring-applied.

SJ= So. Junction (fall-applied)

Table 2 - Post-cut treatments for bladder campion control.

Treatment	Rate (kg/ha)	Visual Ratings	
		Crop Injury	Weed Control
Harmony	0.01	7.1	6.5
Harmony	0.02	6.7	6.5
Harmony	0.03	6.7	6.1
DPX L5300	0.005	5.6	9.0
DPX L5300	0.010	5.3	9.0
DPX L5300	0.015	4.1	9.0
Sencor	0.2	7.1	6.5
Sencor	0.3	6.8	6.0

Culbac for Hay and Silage

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Introduction

Forage is conventionally conserved as either hay or silage. The nutritive value of forages is high in early stages of growth and declines with maturity due to increased lignification. Weather conditions are not always conducive for harvesting of forages at the optimum time in terms of crop nutritive yield. Farmers, therefore, must either wait for favorable weather conditions and harvest a hay crop of lower nutritive value or make silage.

The indeterminate patterns of weather and its potential adverse effects on hay quality coupled with frequent inconsistencies in quality of silage have led to a considerable research effort in the development of a wide range of additives and preservatives for hay and silage. Considerably less effort has been expanded on the assessment of these products under field conditions.

Culbac†, an additive distributed by May and Baker Canada Inc., is a non-viable Lactobacillus acidophilus fermentation product that is sold in solid, Culbac (dry), or liquid, Culbac (liquid), forms. The product was first marketed in the United States in 1975 and has since moved into the Canadian market. Forages for which Culbac has been recommended include alfalfa, cereals, corn, forage sorghum and whole plant sorghum (Bolsen and Heidken, 1985). Manufacturer's claims for the product when used as a silage additive include: more nutrients for feeding, promotion of fast reduction in silage pH; improved conditions for rapid multiplication of beneficial bacteria in silage; and reduced silage deterioration when exposed to air during storage or feedout (Bolsen and Heidken, 1985). Manufacturer's claims for Culbac when used in hay production systems are less clearly defined, but do include include reduced field and storage losses of dry matter and nutrients. A survey conducted by Manitoba Agriculture listed the cost of Culbac to the producer to be $2.40/tonne hay equivalent.

Objectives of this trial were to determine: 1) the effect of Culbac on drying rate and field nutrient losses when harvesting alfalfa as hay, and 2) the effect of Culbac on fermentation temperatures and fermentation nutrient losses when harvesting alfalfa as silage. Also, the stability of silage upon exposure to air was compared for untreated and Culbac treated silages.

Materials and Methods

HAY TRIAL. Twelve 0.2 ha plots of 2nd cut alfalfa were randomly assigned to one of two treatments at the time the forage was cut. Plots designated as CONTROL were cut using a haybine when the alfalfa was at mid bloom. The forage was baled when the moisture content of the material in the swath fell below 25%. Plots designated as CULBAC were harvested in the same manner except that a 2% solution of Culbac (liquid) was applied at a rate of 4.9 litres/tonne D.M. at the time of cutting. The Culbac was applied using a SHR-1 low volume sprayer[†] mounted on to the haybine.

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†Culbac Forage Products are a product of Trans-Agra International, U.S.A.

Forage dry matter yield and nutrient concentrations were determined for each plot at the time of cutting. Bale weights and a composite of core samples from bales in each plot were used to estimate field dry matter and nutrient losses. Also, dry matter of forage in the swath was determined for 0, 2.5, 5, 100 and 124 hrs after cutting. Sampling time for dry matter determination was influenced by precipitation patterns.

SILAGE TRIAL. Six experimental concrete silos (≈1 tonne capacity) were filled with chopped alfalfa forage. A 2% solution of Culbac (liquid) was applied at the time of cutting to forage assigned to three of these silos (designated as CULBAC). The remaining three silos (CONTROL) were filled with untreated forage.

Burlap bags were placed in each silo to determine changes in nutrient composition. Silage pH, ammonia and fermentation acids were measured. Silage temperature was monitored from fifteen sites within each silo for a period of 50 days from the time silos were filled.

To determine silage stability upon exposure to air, silage was removed from the silos, placed in 5 gal. pails and allowed to stand at room temperature. Changes in temperature were recorded for four days. Not all of the silage trial data have been collected and therefore the results presented in this report are incomplete.

Results and Discussion

HAY TRIAL. The hay was baled five days post cutting. Precipitation during that period of time totalled 54.4 mm. Drying rate in the swath during the first five hours post cutting was not influenced by Culbac treatment, the rates being 2.2% and 2.4%/hr for CONTROL and CULBAC, respectively. Drying rates after 54.4 mm rainfall were not influenced by treatment.

Field dry matter and nutrient losses were low (Table 1) and did not differ significantly for control and Culbac treated forages. One reason for low field losses may have been related to the moisture content of the forage at the time of baling which was 24,7 and 23,9 for CONTROL and CULBAC, respectively.

SILAGE TRIAL. Treating alfalfa forage (27% DM) with Culbac at the time of cutting resulted in reduced fermentation temperatures during the first seven days after ensiling (Table 2). Normal fermentative processes can operate up to temperatures of 50°C. Above this temperature the Maillard reaction becomes much more important, although it may be detectable at temperatures as low as 30°C over long periods (Van Soest, 1982). The consequences of heating are losses in digestible nutrients through respiration and in digestible protein through binding in the Maillard reaction. The number of times in which readings over 40°C were recorded was greater for the CONTROL silage than for the CULBAC silage.

[†] SHR-1 low volume sprayer is the recommended equipment for application of Culbac (liquid). The sprayer is a product of SHRCO, Inc., 4823B Aviation Way, RT-3, Box 174, Caldwell, Idaho 83605.

To date analyses for nutrient and fermentation acid concentrations and pH of the silage have not been completed.

There were no differences between treatments for silage stability upon exposure to air when measured by temperature changes over 4 days.

Conclusions

Culbac (liquid) did not influence drying rate or field nutrient losses of 2nd cut alfalfa hay when exposed to heavy precipitation (54.4 mm) while lying in a swath. Culbac (liquid), when applied at the time of cutting, did appear to reduce fermentation temperatures of alfalfa ensiled at 27% DM but had no effect on silage stability upon exposure to air.

Literature Cited

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Van Soest, P.J. 1982. Nutritional ecology of the ruminant. O & B Books, Inc., Oregon, U.S.A.

Table 1. Effect of Culbac (liquid) on dry matter and nutrient losses in the field for alfalfa conserved as hay

	Treatment	
Field losses, %	Control	Culbac
Dry matter	9.3	10.4
Crude protein	12.3	14.8
Acid detergent fibre	8.4	8.8
Calcium	17.7	17.3
Phosphorus	19.1	19.8

Table 2. Mean temperatures (^{o}C) of forage material ensiled with and without Culbac

	Treatment	
Days after ensiling	Control	Culbac
1	25.5	24.0
2	29.7	28.6
3	35.5	28.7
4	31.9	30.0
5	31.2	29.7
6	31.2	29.2
7	31.3	29.1
9	29.9	28.3
11	25.9	25.8
13	24.9	24.6
20	19.8	20.1

POCKET GOPHERS: THE PROBLEMS: THE NEEDS

George Bonnefoy
Manitoba Agriculture

Description:

The pocket gopher often referred to as a 'mole' seems to have only one objective in life, and that is to dig in search of food. It uses its incisor teeth as a pick and the fore claws move the dirt. A pocket gopher, in action throwing dirt, will put a sewer digger to shame (a Tasmanian Devil so to speak). The incisor teeth also grow continually throughout the life of the animal to compensate for continued wear, and it has been found that the lower incisors of the northern pocket gopher may grow as much as 42.5 cm in a year. They are called pocket gophers because they are not only burrowers ('gophers') but also have cheek pouches in which to carry roots and other food for storage in underground chambers.

Habitat:

Pocket gophers live underground in borrows consisting of main tunnels running more or less parallel to the ground surface. Accumulated dirt is pushed from the excavations to form characteristic crescent shaped mounds of soil.

An entire tunnel system is usually built and inhabitated by one gopher, which seldom leaves except to find a mate. These animals are not sociable, fighting other gophers they meet with exception of the mate. The animals are seldom seen, since almost their entire life is spent underground.

Food:

The food of the pocket gopher consists chiefly of the roots, tubers, bulbs, and stems of plants, but includes the leaves of forage plants and small fruits and grains. Alfalfa is the preferred food of the pocket gopher.

Problems:

The pocket gopher has become a serious agriculture pest in cultivated alfalfa fields. Grazing ranges, orchards, parks, forest plantations, airports, and elsewhere. The pocket gopher has readily adapted to changed conditions brought about by agriculture and within their range agriculture has favored their increase by reducing their natural enemies and expanding their food supply and thus increasing their possibilities for damage. Such crops as alfalfa and clovers furnish them excellent food and harborage, since these crops are generally grown on the same land for a period of years. Increased alfalfa production has been especially favorable to the pocket gopher.

This has resulted in a great increase in the numbers of these rodents in many agricultural districts and consequently have intensified their destructiveness and make control measures necessary. It is not uncommon for one pocket gopher to cover .4 hectares or more of ground with its mounds. Many single systems of runways extend more than 244 meters. A single pocket gopher can excavate more than a tonne of earth a year and produce 30 to 50 mounds a year. The mounds are a costly hazard to mowing equipment in hay meadows and alfalfa fields.

Area:

The pocket gopher is found in a wide variety of soil types and conditions. Pocket gophers prefer a sandy or loose soil where the digging is not too difficult.

The following map outlines the 1.8 million hectares of Manitoba farmland susceptible to serious pocket gopher infestation. Within this area, an estimated 160 000 hectares of forage land involving some 850 farmers are seriously affected by pocket gopher infestations. These infestations generally concentrate on Manitoba's light textured soils as follows:

Central Region	-	68 000 ha	-	St. Claude Almasippi sands
Southwest Region	-	52 000 ha	-	Souris and Stockton
Northwest Region	-	36 000 ha	-	Swan River and Dauphin
Eastern Region	-	6 000 ha	-	Steinbach
		162 000 ha		

An additional 200 000 hectares of Manitoba forage lands are more moderately affected by pocket gopher depredation.

Concentrations:

Although pocket gophers tend to occur in small scattered populations they may increase to become a serious pest when conditions are suitable, as they often are in cultivated areas. In a survey conducted in the St. Claude area in 1984, recording pocket gopher damage, it was found that concentrations could be in excess of 50 gophers per hectare. A St. Claude farmer trapped 436 pocket gophers during the spring of 1984 in an 8 hectare field of alfalfa without satisfactory control. Another farmer in the LaBroquerie area reported that 775 pocket gophers were trapped on 320 hectares of alfalfa.

Damage Caused By Pocket Gophers:

(1) Yield losses by (a) Consumption of plant material. A pocket gopher consumes 14 kilograms of plant material per year. An infestation of 50 pocket gophers consume 273 kilograms X 20% DM X 160 000 hectares @ $50 per tonne = $1.2M.

(b) Cutting height losses. Plants are normally cut at 10 cm from the ground at harvest time. Pocket gopher mounds necessitate cutting height to be increased by 5 cm. This loss equates to an 8.3% loss in yield or 8.3% X 1.85 tonnes per hectare X 160 000 hectares @ $50 per tonne = $3.0M.

(c) Mound losses. A survey of forage fields in St. Claude area in 1984 indicated an average of 1213 mounds per hectare. Each mound covered an average of .46 m^2, therefore these mounds can cover 5.5% of a hectare. Losses due to the smothering effect of the dirt is estimated to reduce the yield by 50% within the area covered by these dirt mounds. These losses equate to 5.5% mound area X 4.1 tonnes per hectare X 160 000 hectares X $50 per tonne = $1M.

These yield losses total approximately $5.2 million annually to Manitoba forage producers.

(2) Forage stand longevity is reduced 33% to 50% by pocket gophers. On the average six year stands are reduced to 3 years. The reseeding and establishment costs to growers amount to an additional $52.50 per hectare per year for operating and fixed costs. This amounts to approximately $3.8 million annually to Manitoba forage producers without considering the wind and water erosion potential instead of having the land in perennial forage cover.

(3) Machinery breakdowns and wear. Up to 70% of forage harvesting breakdowns are associated with gopher activities. Based on average machinery operating costs of $22.25 per hectare, savings of $12.50 per hectare can confidently be predicted. This amounts to $2M annually.

(4) Forage quality losses and spoilage. Soil contamination is estimated at 5% based on survey results. Damp soil picked up during baling operations causes heating and spoilage in these bales resulting in reduced palatability and increased feeding losses. Such losses are difficult to equate to a dollar figure, but are significant.

(5) The speed and efficiency of forage harvesting is reduced due to pocket gopher mounds because the field speed of the harvesting equipment must be reduced. These losses also are difficult to estimate but are certainly substantial in years of inclement weather.

The total of these losses to forage producers in Manitoba affected by pocket gopher depredation to be $11 million annually. Similar losses were estimated by A.E. Kolach in 1975. His study indicated annual losses totalling thirteen million dollars ($13M) to approximately 480 000 million hectares of forage land in Manitioa affected by pocket gophers.

*Data from Nebraska indicates yields of alfalfa are reduced by 35% due to pocket gopher activities. Document Source.

Control:

Pocket gophers are particularly active in spring and fall when new mounds of freshly excavated earth are most noticeable in infested fields. Since the pocket gopher spends most of his life completely underground with no visible opening to the outside the control of this rodent is both difficult and costly. The most common methods employed in destroying pocket gophers are poisoning, trapping, flooding, fumigating and shooting. To accomplish adequate control a combination of two or more of these methods is often necessary.

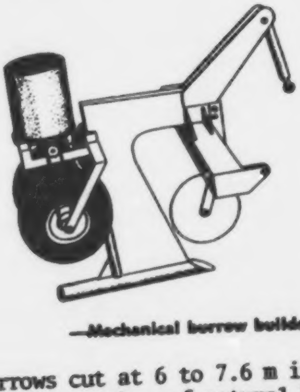
Poisons:

Best results are usually accomplished by using poisons in early spring when gophers are active near the surface of the ground or in the fall after harvest provided the soil is moist enough to hold its shape. During summer months they are best controlled with traps.

A variety of new poisons are being developed but some are extremely dangerous to handle and few are available commercially. The most reliable poison is Strychnine alkaloid on a bait of diced carrots or sweet potatoes, but since this bait is difficult to apply mechanically, the bait most commonly used is treated oats or milo seed. Oat bait is treated with a 2% concentration of Strychnine alkaloid product at the rate of 1 (250 mℓ) can of 2% Strychnine alkaloid on 2 kilograms of oats on 1.54 hectares. Oats, wheat, barley, and milo-maize seed can be used as bait.

Pocket gophers vary in their tastes, and all individuals in the same locality may not accept the same bait. These baits can be applied by the mechanical burrow-builder machine designed in the late 50's. This is the most economical and effective method of controlling this pest although many growers and some researchers have reported less-than-satisfactory results when using this technique with the current available rodenticide (Salmon & Gorenzel 1981).

These machines construct artificial burrows and bait seed them in one operation. The artificial burrows intersect the natural runways of the gophers, which are attracted to the bait by curiosity and a tendency to investigate any disturbed soil. The burrow-builder consists of a tool carrier bar with a subsoiler shank, a coulter disc and frame, and a torpedo about three inches in diameter and 50 cm long at the end of the subsoiler shank (Figure 1).



—Mechanical burrow builder.

Artificial burrows cut at 6 to 7.6 m intervals across the field will intercept a maximum number of natural burrows, and will do very little damage to crops of alfalfa or grass. This treatment is most effective in spring and fall when the gophers are active and the soil is moist enough to hold its shape. If the soil is too dry the artificial burrows will collapse. When a large block of land is poisoned, it is adviseable to hand-poison or hand-trap the few gophers that are not killed. These animals, if left unchecked, will repopulate the field.

Trapping:

The most successful types of traps are firstly the Macabee and next the box type with choker loop. Traps are quick and positive when properly used, and last indefinitely. However, they are labor intensive and costly to use in a large area.

Fumigants:

Attempts to control these animals by using gas are not very effective. Methyl bromide is perhaps the most efficient gas but is capable of only a 50 to 60 percent kill as compared with estimates of 80 to 100 percent for poisoned bait.

Natural Enemies:

The cayotes, fox, weasels, badgers, owls, and hawks are important natural enemies of pocket gophers and should be protected for this reason.

Suggestions For Control:

At this time, I would suggest a two-fold approach consisting of:

a) An organization to assume responsibility for extension and applied research including the testing of rodenticides and keeping up with current research information as this is the basis for successful programs.

b) A local community action group to carry out an organized pocket gopher control program.

The objectives of the organization would be:

1. To investigate and evaluate methods of improving the productivity and longevity of alfalfa fields affected by pocket gophers.

2. To demonstrate new and improved methods of reducing forage losses caused by pocket gophers.

3. To provide information and recommendations to producers to increase economic returns from forage and livestock production.

The following activities conducted would include:

1. Investigate the latest research by a literature review and discussions with researchers involved in pocket gopher programs.

2. Investigate and evaluate various rodenticides including fumigants, toxicants, and repellants for their effectiveness, timing, rates, etc. - both those presently licensed and those available under research permit (e.g. Strychnine alkaloid, aluminum phosphide, anhydrous ammonia, sodium fluoroacetate 1080).

3. Investigate and evaluate traps and trapping methods (e.g. Macabee gopher trap, Death-Klutch Gopher, and Mole trap).

4. Investigate and evaluate cultural and biological control techniques (e.g. buffer strips, parasites, tolerant alfalfa varieties).

5. On a limited basis, demonstrate methods of application of rodenticides (e.g. burrow builders, hand probes). Additional demonstrations may be conducted by the regions in co-operation with the Association.

6. On a limited basis, demonstrate field levelling equipment and techniques (e.g. drag bars, rotary tine harrows).

7. Evaluate the cost-benefits of various methods used to minimize the forage losses caused by pocket gophers.

8. Provide technical information on forage management and pocket gopher control to forage producers (e.g. video tapes, factsheets, field demonstrations).

A local community action group:

Effective control of pocket gophers requires persistent, systematic and coordinated efforts throughout the community. In general, most persons may rid his own premises by intelligent use of poison and traps, but unless the entire community unites in active and close cooperation the area thus cleared will quickly be reinfested from adjoining lands. Careful attention must be given to all infested lands farmed, vacant or public. This applies particularly to waste lands along fences, streams, public highways, and railroads. Such places are favorite haunts of the pocket gopher because the soil is easily tunnelled succulent roots furnish food and their is usually little disturbance from cultivation. It is from such areas that adjoining cleared premises are often reinfested. Once the majority of landowners decide on a control program they should:

1. Call a local meeting to elect an executive from the membership.

2. Determine the number of producers and acres that must be treated.

3. Arrange for expenditures of funds necessary to finance project activities.

4. Decide on a plan of control acceptable to the majority of the members.

5. Decide if the operations should be supervised by a person well qualified in both rodent control and organizational ability to control activities; otherwise many mistakes are likely to be made and the project may fail through inefficient organization.

6. Select bait, poison, machinery to carry out field operations.

7. Decide on time and rates of application.

8. Evaluate results.

The pocket gopher is extremely well adapted for survival. On account of its underground methods of living it will be like some of our other burdens - always with us.

Control programs can only hope to reduce the levels of infestation to tolerable limits. Even this objective seems optimistic in view of the fact that this family of rodents number in the hundreds of varieties all differing in tastes and habits.

EMERGENCY HARVESTING OF FORAGES

Vaughan Greenslade, Manitoba Agriculture

Heavy rains this past summer have clearly demonstrated the need for ways and means to reduce spoilage of forages harvested in periods of wet weather.

Investigations this fall in the St. Claude area indicate significant mold growth to a depth of 30 cm in round hay bales stored outside in a single uncovered row. This 30 cm thickness on a round bale equates to approximately 50% spoilage loss in the dry matter weight of the bale. Most often stacked bales showed more spoilage than when left as a single row. Square bale stacks showed similar heating, mold growth and subsequent spoilage, often 5 bales down in the stack.

Losses such as these have a tremendous impact on economic and feeding value of the forage. Taurpalins and hay shelters clearly paid dividends to those producers using these methods to store their hay. Unfortunately not all producers have hay shelters to ensure safe storage of their crop.

There are a number of options available to assist in harvesting and storing forage crops in years of inclement weather. These include the following:

1. Drying agents - most often using potassium carbonate or its derivatives, which reduce dry down time between cutting and baling;
2. Round bale silage - which will assist controlling ensiling process by ensuring an anaerobic condition;
3. Silage innoculants - such as the lactobacillus based products, which increase fermentation rate and pH stability;
4. Preservatives - such as organic acids (i.e. proprionic), ammonium proprionate, or sodium sulfate which reduce growth of molds and bacteria;
5. Preservatives - such as anhydrous ammonia and nitrogen based products, which again reduce growth of molds and bacteria and which may be used to increase the feeding value of forages.

The use of drying agents such as potassium carbonate compounds are applied ahead of the cutting bar and reduce initial dry down time of the forage. These products do not, however, reduce the rate of drying when the crop is rained on prior to harvest. The cost effectiveness of this method is seriously questioned in a dry climate such as ours in southern Manitoba.

Round bale silage can be utilized in periods of wet weather by using conventional harvesting equipment with little additional expense excepting the purchase of a plastic cover for the silage. Individual silage bags are available, as well as the potential of stacking bales in such a configuration as to accommodate covering by a plastic sheet. Critical sealing of the bags and plastic is required. Covering a stack for silage will require double covering the stack with 6 mil black plastic sheets to provide reasonable confidence in ensuring an air-tight seal throughout the storage period. The plastic is continually subject to puncture from vermin, wind and foreign object damage and must be checked continually throughout the storage period for damage.

When moisture content of forage is between 50-60%, round bale silage is a viable alternative. The bales must be made of a size so that equipment (i.e. loader) can handle their weight and packed firmly and uniformly throughout the bale to exclude as much air from the bale as possible. The bales must be hauled, stacked, and covered immediately and remain sealed for a period of at least 21 days and until feeding. When opened the stack should be used within 4 - 5 weeks to reduce losses from secondary fermentation.

Silage innoculants such as the lactobacillus products may improve quality of some ensiled forages which have low natural levels of lactic acid fermenters and low carbohydrate reserves, such as legume hays. Bacterial action and mold growth, along with unstable pH levels, can often be found in silages put up in round bales. These products are often metered into forage in the harvesting equipment because they require accurate application rates and uniform distribution throughout the forage. The costs of the products are significant and the concentrations of innoculum per tonne of silage treated often raise questions as to their contribution toward the ensiling process. Their use should be cautious until research justifies their effectiveness in Manitoba.

Organic acids do reduce mold and bacterial growth which cause spoilage, however, these products are caustic to handle and require care and special equipment for their use. Other products, primarily anti-oxidants, are applied in granular form at the baler. To be effective these treatments require the moisture content to be 20-25% and both the cost and their effectiveness is no better than using the ammonia based products. Because of this and the availability of product and equipment, their use in Manitoba will likely be minimal compared to ammonia products.

Anhydrous ammonia and other nitrogen based products such as feed grade urea will also reduce mold and bacterial growth, and are readily available. Anydrous ammonia is caustic to handle; therefore proper safety procedures must be observed.

Feed grade urea can be applied at the baler by utilizing an applicator calibrated for granular material (i.e. Gandy applicator). When urea is incorporated into moist forage (20-30% moisture content) sufficient amounts are hydrolysed to ammonia to provide reasonable preservation properties. The remainder of the urea is retained as a solid or in a gaseous solution. An alkaline condition will result in the hay and during storage should result in an increase in digestability by modification of the cellulose, hemicellulose and lignin. The advantage of urea treated hay is that it does not have to be covered during or following the treatment.

The use of anhydrous ammonia at rates of 2% of dry matter weight of the forage (40 kg/tonne dry matter) has been the most widely adopted means of preserving the quality of moist forages up to moisture contents of 40%. Research has indicated that by increasing the ammoniation levels to 3-4% (60-80 kg/tonne dry matter) corresponding increases in both the palatability and digestability will occur. Work conducted by Gramiak, Stewart, and other Manitoba Agriculture staff has often increased protein levels by 100% when ammoniating low quality roughages.

When a planned approach is used, the forage can be harvested at 20-30% moisture content. The bales should then be hauled, stacked and covered as quickly as possible with a sheet of 6 mil black plastic. The plastic must be sealed around the total periphery of the stack with sand or soil to ensure a good seal with the ground surface. Round bales are normally stacked in an A-configuration (three on bottom, two, then one on top), fourteen (14) bales long for a total of 83 bales to maximize the number of bales under a standard 12.2 x 30.5 m sheet of 6 mil black plastic. It is important to include as many bales under the plastic sheet as possible since the cost of the plastic is a major portion of the cost of this process. After the plastic has been sealed, anhydrous ammonia is injected under the plastic at rates of 2% of dry matter weight for preservation or 3 - 4% of dry matter weight for increasing the feeding value as well as preservation. After the ammonia is injected the holes at the injection site of the plastic are sealed with a plastic patch attached by duct tape or commercially available caulking, depending on weather conditions. (Caulking is often used in cold or wet conditions.) Remember that anhydrous ammonia is very caustic to eyes and skin. Use all recommended safety procedures and be careful. This stack is then left covered until feeding time for maximum protection.

When ammoniating to increase feed quality, at 3-4% ammoniation rates, the stack must be left covered for at least three weeks. When ammoniating in cold weather ($< 0^{\circ}C$) the stack should remain covered for four to five weeks. Again, the stack should remain covered until feeding for maximum benefit.

When dealing with forages baled in good condition and then soaked by heavy rainfall, which happened in many portions of Southern Manitoba this summer , spoilage from bacterial action and mold growth will begin rapidly in periods of warm weather. Injection of anhydrous ammonia will stop all bacteria and mold growth; however, it will not rectify spoilage that has already taken place or alter any toxins which may have been formed. It is important therefore to initiate preservation procedures as quickly as possible after such rains.

The cost for ammoniation is approximately $10-12 per tonne for preservation and $17-19 per tonne to increase feeding values. These costs are well justified in an emergency situation to reduce spoilage losses which reached 50% and greater in many areas of the province this summer.

The use of anhydrous ammonia and other nitrogen based products such as feed grade urea, in my opinion, will be used as the preferred method in emergency harvesting and storage situations in Manitoba at the present time. Both products are readily available and are effective from both a cost and preservation standpoint. As well, these products have the flexibility of being able to be used to increase the feeding values of low quality forages.

MANITOBA FORAGE SEED PRODUCERS' ASSOCIATION

Gerald Huebner
Agricultural Representative
ARBORG

The Manitoba Forage Seed Producers' Association -- what is it? The Manitoba Forage Seed Producers' Association is a provincial producer organization founded in late 1983 and has a membership of 65. The organization was formed by a group of active forage seed producers who saw the need for developing more information on forage seed production. The producers were convinced that a great deal of information already exists, yet much of this information was not reaching the Forage Seed Producers in Manitoba. Out of these concerns the organization was launched with the objective of enhancing the forage seed production industry in Manitoba.

Many of the producers involved in the formation of the association had been or are involved in the Manitoba Alfalfa Seed Producers' Association (formerly Leafcutter Bee Association) and felt this type of effort was needed for other forage seed crops produced in Manitoba. Our organization would commend the Alfalfa Seed Producers' Association for their work over the past number of years and have greatly appreciated the work done by the University of Manitoba, Manitoba Agriculture, and Agriculture Canada even though this work often receives little support from many agencies. In particular, the association commends people like Dr. Anna Storgaard for her valuable work in forage variety trials. The Association hopes for the continuation of this work and plans to support it in anyway possible. We hope to continue to build on work which has been started in the past, such as the forage herbicide screening trials. The Association plans to follow up on promising treatments from these trials which were carried out by Manitoba Agriculture.

The Forage Seed Crops that the Association is concentrating its efforts on are Timothy, Birdsfoot Trefoil, and Alfalfa. A number of others such as Kentucky Bluegrass, Clovers and others showing potential in the province will also be examined over the next few years.

The aims of the Association are as follows:

1) to collect and make available to producers information on forage crop production through meetings, tours, newsletters, and publications.
2) demonstrate desirable production practises through field scale and small plot sites.
3) work in cooperation with the Seed Trade, Department of Agriculture and universities to enhance the Forage Seed Industry in Manitoba.
4) cooperate with other agricultural groups in the promotion of improved production of Forage Seed Crops.

5) to deal with marketing issues only as they relate to future trends and developments in the Forage Seed Industry.

The activities of the association are managed by a Board of Directors. The Board consists of seven active forage seed producers. A representative from Agriculture Canada, Manitoba Agriculture, the University of Manitoba, (Faculty of Agriculture, Plant Science) and a representative from the Seed Trade as well as a representative from the Manitoba Alfalfa Seed Producers' Association.

Since the formation of the organization some activities have occurred and many more are planned. The association has -

1) Held two Annual Field Days and Tours which were both highly successful and well attended.
2) Held one Annual Meeting and Production Seminar.
3) Made representation to the Plant Products and Quartine Division with regard to Thiram treatment of seed and feel they have had an input along with other organizations on this issue.
4) In June of 1985 the association signed a contract with the Provincial Department of Agriculture to carry out an investigation and demonstration project.

This project has a five year duration and is planned to fill many of the information needs expressed by producers. Much of the work already done has not been specific to seed production, so specific investigations into affects of various factors on seed yield are planned. Some of these include:

a) Weed control - a follow up on results from herbicide screening trials, timing of application, and non-registered treatments.
b) Fertility - investigations into timing of application formulations, carriers, and rate of application.
c) Cultural Practises - investigation into seeding practises such as row spacing and stand density.
    - burning or not burning
    - growth regulators

These and many other investigations will occur over a five year period. Some of this has already begun with the establishment of a number of sites. One being a timothy fertility site, the other a five acre investigation site designed to look at weed control, fertility and cultural practises on timothy, alfalfa and Birdsfoot Trefoil. Other crops will be added in later years as their potential is identified.

The initial phase of the project is to carry out investigations into work already done in various areas. Then with this information make plans for further study, investigation and demonstrations.

Investigations so far have shown a great need for more work in forage seed production under Manitoba conditions. Producers in the Association continually point to production practises being utilized in areas of the United States and see their apparent success. Yet the information needed to evaluate the transfer of these practises to Manitoba is sketchy or nonexistent. It is hoped that practical application to Manitoba producers can result from these investigations.

Membership in the organization is open to anyone interested in forage seed production in Manitoba. Memberships of three types are available.

1) Active Membership - for active producers.
2) Associate Membership - for individuals not actively producing.
3) Patron Member - for firms or organizations interested in forage seed production.

Memberships are available at $25.00 for 1986 and $100.00 for patron members. For anyone interested in joining, a membership brochure is available today or those wishing more inforamtion should contact me. A regular newsletter is published which will keep members up-to-date on current developments and activities of the organization.

Thank you for this opportunity to share the new association with you, on behalf of the Board of Directors I would like to extend an invitation of membership and indicate the eagerness to work cooperatively with many of you in enhancing the forage seed production industry in Manitoba.

CHALKBROOD REPORT

Hugh Rutherford
Project Supervisor
Manitoba Alfalfa Seed Producers' Association
St. Norbert, Manitoba

Introduction:

Chalkbrood disease, caused by the fungus Ascosphaera aggregata, appeared in leafcutter bee stocks near Gimli in 1982. Losses due to the disease were low (2.5 - 5.0%), but the fact that it was detected concerned producers in a province considered to be disease free. In 1984/1985, the disease was detected in two other Interlake operations.

Historically, the disease increases dramatically once it has become established. If left uncontrolled, it could reach epizootic levels of 30% or more, as it has in many of the States in the Northwest USA at present, striking a hard blow to a promising industry. Without question, Chalkbrood disease is an eminent threat to leafcutter bee and alfalfa seed production in Canada.

Chalkbrood Project:

The Agri-Food Project, proposed by the Manitoba Alfalfa Seed Producers' Association (MASPA), has now completed its first year. The objectives of the three year project are to demonstrate, develop, and investigate methods of controlling and/or preventing Chalkbrood disease in Manitoba Leafcutter Bee Stocks.

This year's program examined:

1. Chalkbrood identification.
2. Manitoba leafcutter bee stocks by way of a producer survey.
3. Chalkbrood establishment in three areas of Manitoba.
4. Recent research findings.

[Unlike previous years, the project is coordinated by a part-time supervisor employed for three 6 month terms.]

Description:

Chalkbrood is transmitted by means of microscopic spores which adhere to the external body hairs of adult bees. The female leafcutter bee procures the spores during foraging and nesting activities, subsequently contaminating provisions of pollen and nectar. The developing larvae feed upon the contaminated food and, in doing so, ingest the spores. Inside the gut, the spores germinate then grow to invade the body cavity, ultimately killing the larva.

Chalkbrood can be recognized mainly by its two forms, dark sporulating or light nonsporulating. The dark sporulating form is dry, hard, dark grey, or black in color and appears to have a sheen as if wrapped tightly in cellophane. Beneath the shiny outer layer (the integument) are hundreds of black spore cysts each containing thousands of spores. One sporulating cadaver can enclose over 10 million spores and has the potential to infect whole operations. Since the infected larva dies before completing its cocoon, the cell crumbles easily when tumbled or rolled between one's fingers.

The light nonsporulating form is described as brassy/tan to cream in color, dry, hard, and lacking dark spore cysts beneath the integument. Occasionally, intermediate types can be found. A partially sporulating Chalkbrood cadaver may be tan in color but exhibit incomplete spore cyst development. Common to all forms is the shiny cellophane wrapped appearance.

Chalkbrood Survey:

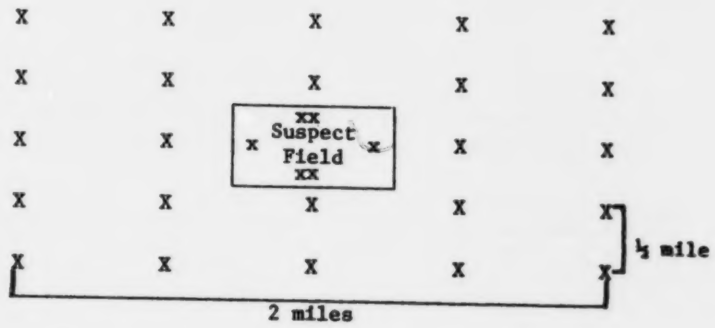
The purpose of the cocoon survey was to locate and evaluate Chalkbrood disease in Manitoba. In late spring, eighty-seven (87) boxes with a request for a 250 gram representative sample were sent off to selected beekeepers. Thirty-one (31) samples were received and later analyzed. Individual beekeepers were notified of their results. No Chalkbrood could be identified but there was evidence of plant molds. The amounts occurring can present a problem to producers if left unchecked.

Monitoring Program:

During 1985, three major areas; Gimli, Arborg, and Fisher Branch were monitored with the involvement of 29 cooperators. Three (3) beekeepers had been directly implicated with the disease in 1984. This year's monitoring program was an expanded version of earlier work conducted by MASPA. Recent and past Chalkbrood sites were selected for the study. In total, one hundred and thirty-one (131) trap nests were installed.

Major Chalkbrood sites were set up in 2 mile squares according to the following diagram:

Diagram: Trap Nest Placement At A Major Monitoring Site



X = one trap nest

Conclusion:

Chalkbrood, Ascosphaera aggregata, continues to be a problem and a threat to Canadian leafcutter beekeepers. Following recommendations as outlined in PestFacts 'Chalkbrood Disease In Alfalfa Leafcutter Bees', Manitoba Agriculture, Agdex No. 616 - June, 1984 is suggested to control and/or prevent the disease.

Project Proposals:

In its second year, the Agri-Food Project expects to carry out field investigations of currently employed sanitation procedures. For example, attempts will be made to evaluate and develop processes such as tumbling, dipping (cocoons and nesting material), fumigation, and heat-treating. Other control measures under consideration include macrowave/microwave sterilization and the application of fungicides. The primary involvement of the project, though, will be educational. Intensified publicity by means of newsletters, tours, workshops, and the Media is anticipated. At the conclusion of the project, a practical set of recommendations will be prepared in a guide to Chalkbrood disease control.

1985 Survey Of Manitoba Leafcutter Beekeepers:

- H. Rutherford and R. Jensen.

From each of the 31 samples, four (4) subsamples (15 grams each) were taken. They were examined for live larvae (LL), discolored dead larvae (DD), moldy dead larvae (MD), chalkbrood (CB), moldy cells (MC), parasites (PAR), second generation (SG), and empty cells or pollen balls (EPB). On average, a total subsample (60 grams) was 659 cells. All examinations took place at the University of Manitoba.

Categories Examined (in average percent)

	LL	DD	MD	CB	MC	PAR	SG	EPB
avg. %	75%	6%	1%	0%	3%	1%	1%	13%
(range)	(43-91%)	(2-21%)	(0-6%)	(0%)	(0-14%)	(0-7%)	(0-5%)	(5.5-34%)

A short questionnaire had been included in the sample request, twenty-three (23) producers participated. They had been asked the following:

1. nesting material used? WOOD 43.5% POLYSTYRENE 43.5% BOTH 13%
2. tumbled or untumbled sample? TUMBLED 83% UNTUMBLED 17%.

Results: Twenty thousand four hundred and twenty-two (20,422) cells were examined in total without any Chalkbrood being identified. Losses due to plant molds are a problem while parasites, on the average, are apparently under control. Tumbling may remove Chalkbrood cadavers, untumbled samples would reflect a true picture of the disease level.

Note: During the winter of 1984/1985, Barry Fingler, Extension Apiarist with Manitoba Agriculture examined fifty-one (51) samples of leafcutter bee cocoons. Chalkbrood was detected in one case (0.2%). In total, eighty-two (82) producers cooperated in the two surveys. The Cocoon Testing Center in Brooks, Alberta established another case of Chalkbrood in Manitoba in 1984/1985.

1985 Monitoring Program:

One hundred and thirty-one (131) trap nests in total were placed in the field. An accounting of each nest follows:

Table 1. Description Of Monitoring Program Sites

Site	# Of Nests	Remarks
Gimli	30	Major Chalkbrood site.
Arborg	30	Major Chalkbrood site.
Fisher Branch	29	Major Chalkbrood site.
Gimli	10	Request of producer.
Winnipeg	10	Request of producer.
Fisher Branch	9	To trap native bees.
Gimli	9	Follow-up program.
Subtotal	127	Assigned trap nest locations.
Fisher Branch	+ 2	To replace filled nests at major Chalkbrood sites.
Subtotal	129	
Fisher Branch	+ 2	Replacements for missing nests.
Total	131	

Table 2. Methods Of Analysis

# Of Trap Nests	Status	Analysis
33	Empty	-
48	Partially Filled	Examined by hand
48	Filled	Analyzed by X-Ray Technique
Total 129		

Results: Chalkbrood, Ascosphaera aggregata, has been found in the Gimli and Arborg areas. Three (3) nests at Gimli indicate 0.22%, 0.36% and 0.67% Chalkbrood while Arborg has one nest with 0.15%. Both dark sporulating and light nonsporulating cadavers have been identified.

Note: Forty-eight (48) cadavers suspected to be infected with Ascosphaera proliperda have also been identified. 'A. proliperda is pathogenic to the leafcutter bee, at least under laboratory conditions.'[1] The results are being withheld pending verification by the Biosystematics Research Institute, Mycology Section, in Ottawa.

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[1] Nabil Youssef, Carl Roush and William McManus 1984. 'In Vivo Development and Pathogenicity of Ascosphaera proliperda (Ascosphaeraceae) to the Alfalfa Leafcutting Bee, Megachile rotundata' (Journal of Invertebrate Pathology, 43, p. 11 - 20).

SUMMARY OF THE EVALUATION STUDY OF THE GRASSLAND AND FORAGE PRODUCTION & HANDLING DEMONSTRATION & LIVESTOCK PRODUCTION EFFICIENCY DEMONSTRATION

AGRO-MAN PROJECTS 301 AND 304

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Mr. Chairman, Ladies and Gentlemen, I was pleased to be asked to present a summary of our Evaluation Study of the Agro-Man Grassland, Forage and Livestock Demonstration Programs. Our consulting group completed this evaluation in September 1985. It was quite satisfying and enjoyable evaluating such a successful program and I look forward to discussing it with you. However, before I begin, I would like to thank those farmers and Manitoba Agriculture staff who so willingly participated in this review, supplied data, and provided constructive thoughts as to the value of the program and how future programs could be improved; the willing and helpful response of the Forage and Livestock Specialists was most appreciated.

A special thank you is extended to the coordinators of this required evaluation, Mr. Ross Cameron, Mr. E. W. Somers, and Mr. Alf Chorney. Their guidance and patience has been appreciated.

To the other members of our consulting group, I would like to thank Mr. F. P. Pitura for doing the field work in the Eastern Region, Mr. C. G. Harrison for doing the same in the Central Region, plus a special thanks to Mr. G. A. Arnott for preparing the section in the report on the summary of the results of the questionnaires and reviewing the data on trends in the livestock industry from 1979 to 1983. Appreciation is also extended to these three for their constructive comments and criticisms.

The following summary contains all of the Executive Summary and portion of the Observations and Conclusions from the final report:

I) CAPSULE SUMMARY

In five years these programs have obtained valuable results. The Pasture, Forage and Livestock Programs were appreciated by the cooperators, learning occurred, implementation was affected and the cooperators believed their production and net income rose significantly. The program was flexible and properly financed and therefore responded well to divergent interests throughout the Regions. A considerable potential for increasing productivity as a result of Agro-Man type projects still exists and as such the Pasture, Forage and Livestock Programs should continue. The Agro-Man Program is a credit to those who conceived it, implemented it and participated in the program. It was successful and important to the pasture, forage livestock industry in Manitoba.

II) DETAILED SUMMARY

☐ The Grassland and Forage Production and Handling Demonstrations and the Livestock Production Efficiency Demonstrations were implemented as part of the Canada/Manitoba Subsidary Agreement to the GDA on Value-Added Crops Production for Agricultural Development.

☐ The over-all objectives were:

- To increase the production of value-added crops - i.e. those crops which are processed or have a potential for processing in Manitoba.

- To improve the production of forage crops and maximize their feed value.

☐ To meet these objectives each Region set up major programs in the areas of:

- Pasture management - the grassland projects were brought under the umbrella of the Agro-Man Agreement and their objectives were broadened. The specific purpose of the Association after fulfilling the basic objective of demonstrating sound pasture, forage and livestock management was dependent on the Region and the location within the Region in relation to the needs of the farming community.

- Major demonstrations on pasture and forage were conducted in the areas of pasture management, rotational grazing, complimentary native-tame grazing, pasture renovation, land improvements, sod-seeding and fertilizer use. Learning and technology application occurred on farms.

- Livestock management - (livestock management was also part of the mandate of the pasture association). Major steps taken under Agro-Man were the development of two more bull test stations, the introduction of ROP replacement heifer programs, feedlot and pasture finishing plus some productive programs on sheep and swine. Learning and technology application occurred on farms.

- Forage management - forage production was studied and demonstrated by the use of variety trials, alfalfa and other forage management trials. Demonstrations on how to grow the crops covered fertilization practices, seeding methods covered crops and target production management. Major programs were conducted in the areas of sod-seeding and ammoniation. Valuable information was produced on round-bale silage, silage making and chopped forage feeding. Learning and technology application occurred on farms.

☐ The Pasture Forage and Livestock Programs were a success.

☐ Farmers appreciated the programs, participated in the programs, learned from the programs and believed that their production and net income had increased as a result of participating in the programs. One question asked to what extent and in which areas were these new skills and ideas put into practice. It is interesting to summarize by Region, both the learning and application areas where the producer indicated he had both either learned and/or put into practice the item to a fair or great extent on his farm. The Regional data is ranked in order of number of respondents to a given work area.

Region	'Developed New Skills & Learned New Ideas To A Fair And Great Extent'	'Put Into Practice New Skills And Ideas To A Fair Or Great Extent'
Southwest	Ammonification Forage Varieties Complimentary Native-Tame Grazing Systems Rations Herd Health Feed Testing	Ammonification Rations Animal Nutrition Hay & Pasture Management Complimentary Native-Tame Grazing Systems Herd Health Animal Quality, Feed Testing
Central	Forage Varieties Chemical Weed Control Sod-Seeding Rotational Grazing Fertilizer Use Hay & Pasture Management Rotational Grazing	Fertilizer Use Forage Varieties Rotational Grazing Chemical Weed Control Hay & Pasture Management Sod-Seeding
Eastern	Hay & Pasture Management Forage Varieties Pasture Renovation Fertilizer Use Feed Testing Sod-Seeding Rations Animal Nutrition	Fertilizer Use Herd Health Feed Testing Pasture Renovation Hay & Pasture Management Forage Varieties Sod-Seeding
Northwest	Fertilizer Use Land Improvement Rotational Grazing Sod-Seeding Animal Quality Complimentary Native-Tame Grazing System Feedlot Finishing Implants	Land Improvement Rotational Grazing Fertilizer Use Animal Quality Complimentary Native-Tame Grazing System Hay & Pasture Management Animal Nutrition
Interlake	Sod-Seeding Fertilizer Use Rotational Grazing Hay & Pasture Management Pasture Renovation Animal Quality Forage Varieties Land Improvement	Sod-Seeding Fertilizer Use Hay & Pasture Management Rotational Grazing Forage Varieties Animal Quality Pasture Renovation Land Improvement

The Pasture, Forage and Livestock Programs across Manitoba resulted in both learning of new skills and new ideas and implementation of many of these techniques. The following schematic shows the major areas where sound pasture, forage and livestock management were demonstrated; testing also occurred in many areas.

- Hay and Pasture Management
- Complimentary Native Tame Grazing System
- Rotational Grazing
- Pasture Improvement
- Animal Quality

Fertilizer Use
Forage Varieties
Sod-Seeding
Ammonification
Feedlot Finishing
Chemical Weed Control
Feed Testing
Animal Nutrition
Herd Health

- Herd Improvement
- Breeding Program
- Herd Management
- Average Daily Gain

ROP Bulls
ROP Replacement Heifers
Nutrition
Feed Testing
Trace Minerals
Rations

☐ The magnitude of the production increase demonstrates that there is still ample room for major improvements in the pasture, forage and livestock business. Further demonstration and technology testing programs like Agro-Man should impact significantly on the livestock industry and as such be a real credit to the Governments involved.

Given the harsh conditions associated with the livestock industry from 1979 to 1984 ...poor prices, high interest rates, increasing input costs, drought... the percentage increase in production reported is quite astounding. Please review the following figures.

Change In Production Due To The Pasture And Forage Agro-Man Project 301

Number of Farmers	Percent of Farmers	Production Change
9	7%	up by 25%+
25	19%	up by 20-25%
47	35%	up by 10-20%
38	28%	up by 0-10%
15	11%	no change
1	0%	decrease

Speaking as a farmer, I believe these numbers are very impressive. By these statements, the average producer increased his production by 10 to 20%. If an Agro-Man Project could demonstrate ways that my farm production would increase by 10 to 20% or even 20 to 25% or more, it would dramatically affect my expendable income. As a professional, production discussions were generally on per acre or per unit basis; as a farmer this is important, however, how well production is achieved across the whole farm compared to the total expenses is even more important. It is highly likely that a production increase of this magnitude would be greater than the costs associated with obtaining the increase. Gross production is one figure farmers normally know. Net income is a figure very few farmers use because of the many ways to calculate this figure...net to what, does it include land value, if so, few farmers would be in business in Western Canada. Therefore, it is the writer's opinion that farmers do know what gross production means to them and 89% of this group (over 100 farmers) who responded felt their production had increased by 0 to 25%+; this is significant.

Change In Production Due To Livestock (Beef) Production Agro-Man Project 304

Number of Farmers	Percent of Farmers	Production Change
3	7%	up by 25%+
11	24%	up by 20-25%
11	24%	up by 10-20%
13	29%	up by 0-10%
7	16%	no change
0	0%	decrease

The same comments apply to the on-farm production increase due to the beef cattle production and management Agro-Man Projects. A higher percentage of respondents felt their income had increased 20 to 25%.

At this point, it should be noted that when the cooperators in the livestock projects were asked what future programs they would like to see operated, half of the responses were in the area of beef cattle management and half were in the area of pasture management. Pastures seem to be the topic where the farmers feel they have the most to learn and by learning once again to increase their production.

The cooperators also stated they had an increase in net income. The increase indicated was not as large as the increase in production, however, that would be expected. It is interesting that these livestock farmers felt they had a net income, let alone an increase in net income. The important part of the production increases and as a result the net income increase is that these implemented technologies are the technologies that the producer must introduce to stay alive in the industry today.

Change In Net Income As A Result Of The Pasture, Forage And Livestock Agro-Man Projects 301 And 304

Forage 301			Livestock 304		
No Of Farmers	% Of Farmers	Net Income Change	No Of Farmers	% Of Farmers	Net Income Change
1	1	25%+	2	4	25%+
8	7	20-25%	6	15	20-25%
29	26	10-20%	12	28	10-20%
58	52	0-10%	8	19	0-10%
13	11	no change	13	30	no change
3	3	decrease	2	4	decrease

The net income figures are lower but still quite impressive. A number of farmers commented that the net farm income had not really changed due to other factors. Given the positive response to increases in net farm income and production and especially considering the magnitude of the increase it is fair to say that government funds invested in the Pasture, Forage and Livestock Projects has truly benefited a significant portion of the producers associated with the project. It is also fair to say that these programs should continue especially when there is room for over 15 to 20% production increases.

☐ The success of the Programs was as a result of:

- Sound objectives which required the demonstration of basic recommended pasture forage and livestock practices as a primary requirement of a properly managed project and in addition to this, allowed for and encouraged testing and demonstration of new practices.

- The Agro-Man pasture, forage and livestock organization was well conceived. This government organization was adequately flexible to accommodate regional and area needs.

- Funding was additive to the existing Provincial budgets, therefore expansion in programs occurred, moral improved and results increased greatly.

- Financial control and administration generally functioned quite well and suited the needs of the many varied programs.

- Program initiation was from the ground up - from the Agricultural Representative, Specialist and/or farmer - and as such reflected the area needs.

- After the first year, project approval worked well.

- Numerous activities occurred in extending the results of the demonstrations.

- The participatory association project format was very successful for most programs. Programs which did not fit this design, like Variety Trials, were well administered on a group farmer but on-each-farm design. The Central Region successfully tied numerous smaller demonstrations into group associations.

- Major projects require a technician if they are to be implemented properly and technicians were generally provided.

☐ Questionnaires were sent to over 500 producers who were Agro-Man participants. Over 170 producers responded; they responded as follows:

- The inputs such as dollars and staff were quite adequate.

- Cooperators were very supportive of demonstrations as a method of technology transfer.

- They appreciated the involvement in the Associations because they could:

  * participate in the decision-making process.
  * share input costs

- * meet with neighbours
- * meet with Agricultural Representatives and Specialists
- * view proper pasture and herd management
- * view proper facilities
- * try out new ideas
- * extend findings to neighbours.

- They increased their contact with Manitoba Agricultural staff.

- They felt the Program was effective and efficient and they would recommend participation to their neighbours.

- They felt their attitudes had changed, they would want to continue being a participant and they had gained technical information to assist them in their management.

- They indicated they had learned and implemented many techniques with a resulting increase in production of 10-20% and net income increase of 0-10% and more.

- They believed the Agro-Man Programs had some improving effect on their neighbours.

- They were generally aware of the cost-sharing agreement between the Federal and Provincial Governments.

- They mostly learned of the program through the Agricultural Representative and then media and publications.

- They felt the program had few constraints and recommended areas where they would like future programs.

☐ Questionnaires were sent to over 100 staff and farmer Directors discussing the project organization and administrative effectiveness and efficiency. Thier response was as follows:

- Farmers were more optimistic and/or enthusiastic than staff.

- They felt the relationship between the Association Executive, Manitoba Agriculture and Project Staff was effective and efficient.

- They were quite satisfied with the project work plan and management including:

  - * work plan development
  - * timeliness
  - * staffing
  - * obtaining and using equipment
  - * purchasing
  - * obtaining cooperators
  - * monitary activities
  - * public relations.

- They felt the extension of results was good and that the project has resulted in at least some attitude change in the farm community.

- They felt the program had met its objectives quite well.

☐ As in any program, there are always ways and means of improving the delivery and effectiveness of the program. Consideration should be given to the following as their recognition and/or inclusion would have improved the Pasture, Forage and Livestock Agro-Man Programs:

- An evaluation process should be written into the next agreement. It should include establishing base data at the beginning of the project -- what is there now. An in-term independent evaluation should occur during year four to review how the program is fulfilling its objectives, what modifications may be appropriate to introduce during the final two years and most importantly, should the program continue, and if so, in what direction and with what mandate. This would result in an orderly transition of important programs between the normally reoccurring Federal-Provincial Agreements and would reduce the confusion which now exists.

- Proper recognition should be given to the Federal Government for their contribution to the programs during the formulation and delivery of the program.

- Care must be taken on the part of the Provincial Government to treat the programs as being additive funding to normal program delivery.

- Monitoring of project distribution throughout the regions would be beneficial and care must be taken to assure proper program delivery during staff turnover periods.

- A project format should be prepared prior to the beginning of a program so the first year does not have to be spent determining how to prepare project proposals.

- Annual and Final Reports should be mandatory; further funding should be withheld until they are produced; formats should be developed to assure reporting continuity between Regions.

- An extension coordinator should be part of an Agro-Man style project.

- Associations should be required to have an accountant and an accounting procedure should be set up for smaller projects.

- Priority should be given to hiring competent technicians if larger projects are authorized.

- Consideration should be given to the Association style of project design to tie together individual on-farm projects.

☐ In summary, the Pasture, Forage and Livestock Projects were a success. The success was based on the fundamental strength of their objectives which required the demonstration projects to begin with basic sound pasture, forage and livestock management practices. This was enhanced by good organization, program flexibility and adequate funding. An independent interm evaluation should have been included so that program continuance could occur smoothly, at least in the public eye. Efforts should have been made to have the project approval process easier to follow initially by the preparation of pre-developed formats. The program was very successful, credit goes to all associated with Agro-Man and more programs with these objectives and designs would be an asset to the farmer, to Manitoba, and to Canada.

Flame Chlorosis: A new and damaging virus-like disease in barley in Manitoba

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At present the most serious economic virus disease problem in cereals in Manitoba is the aphid-borne barley yellow dwarf virus (BYDV). In the past, seed-borne barley stripe mosaic virus (BSMV) has presented problems in breeding programs, but persistent efforts in seed sanitation and certification have largely eliminated BSMV as an economic problem. To date, Manitoba appears to have been free of wheat streak mosaic virus (WSMV), wheat spindle streak virus (WSSV) and soil-borne wheat mosaic virus (SbWMV) which have inflicted economic losses in cereal production regions of the American Great Plains states. The presence of any new or hitherto unreported virus disease in cereals should immediately put us on the alert, as the only approaches available for control involve exclusion of inoculum or plant resistance.

The condition described as "Flame Chlorosis" in barley was observed in two adjoining fields of Argyle barley covering ca. 2 ha on the farm of Mr. T. Wareham near Newdale, Manitoba in late June, 1985. At that time, about 30 to 40% of plants (then nearing the boot stage) displayed a striking chlorosis in a "flame"-like pattern and were severely stunted. The afflicted plants were in circular patches and were confined to the two adjoining fields; surveys of the neighboring area at that time, and in mid-July and early August, failed to find plants with symptoms of the flame chlorosis type in any other field.

Plants afflicted with flame chlorosis displayed the chlorotic symptoms on all new leaves which developed. This was monitored on specimens which were transplanted and transferred to growth chambers. The plants transferred to growth chambers did produce heads, but these were mostly sterile and shrunken. Afflicted plants which remained in the field generally failed to produce heads altogether. By early August, a time when healthy plants from the same field were heading, afflicted plants in the field were completely necrotic. Transplants of these afflicted plants transferred to the growth chamber "revived" to produce new basal shoot growth that also displayed flame-like chlorosis.

The nature of the symptoms, the limited geographical extent of affected plants and their distribution within the affected fields, as well as the history of continued cropping with barley in those fields, would point circumstantially to a soil-borne virus as the causal agent. Attempts to transmit the agent mechanically, by leafhoppers, or by cereal aphids have not been successful; preliminary experiments with soil transmission have been inconclusive. Examination in the electron microscope of embedded sections made from leaf tissue showing flame chlorosis symptoms revealed cytopathology of the kind usually associated with virus infection: profusions of small vesicles, and presence of multilamellar formations around the chloroplasts.

Further studies on this unusual, condition in barley are now in progress, including efforts to transmit the agent, and determine whether virus specific double-stranded RNA or virus type-specific cellular inclusions are present.

At present flame chlorosis appears confined to a very limited area; vigilant observation to detect any other occurrences of this, potentially devastating, disease will be of utmost importance for its early characterization and control.

DISEASES OF SAFFLOWERS

G. Platford

In 1985 about 6,000 hectares of safflower were grown in southwest Manitoba. This crop has been increasing in importance in the southwest because it is a crop that is adapted to relatively droughtly conditions. However in 1985 conditions in southwest Manitoba were not dry, particularly during the month of August and this resulted in severe disease problems. Two diseases were noted to be very prominent; Alternaria blight and Sclerotinia head rot. An occasional rust infected plant was also observed, caused by _Puccinia carthami_.

The Alternaria disease was associated with a premature ripening of plants in the field. The disease was diagnosed as being caused by _Alternaria carthami_. The only host of this disease is safflower.

Infections begin as discrete spots which enlarge and coalese under favorable moisture conditions. The fungus which causes the disease is seed borne and can also survive on infected plant debris for several years. Fortunately the new variety Sapphire has some resistance to this disease. Control: (1) sow seed from disease free fields; (2) where available plant the moderately resistant variety Sapphire.

Sclerotinia head rot was a severe problem in several fields causing yield losses up to 40%. This disease is caused by the _Sclerotinia sclerotiorum_ fungus which affects a wide range of special crops including sunflowers, canola, field peas, field beans, lentils, soybeans and fababeans. All infected plants were observed to have the head rot type of infection. A basal stem rot is reported to occur on safflowers but was not observed in Manitoba. Infected heads became a light brown colour. A very unusual top shaped sclerotia develops in the center of the infected safflower head. Control: (1) Sapphire has good resistance to head rot; (2) crop rotation of four years between safflowers avoiding other sclerotinia susceptible crops.

Rust was observed in only a few fields causing a low amount of damage. The safflower rust attacks only safflower and survives overwinter on infected safflower debris. Control: Normal four year crop rotation as outlined for sclerotinia disease should prevent buildup of rust.

Other diseases reported on safflower but not observed in Manitoba are Botrytis head rot, several types of root rot caused by Phytophthora and Pythium fungi. Verticillium wilt which can cause severe damage to sunflowers can also affect safflowers.

Several virus diseases have also been reported on safflower but are presently considered to be of minor importance.

Although plant disease damage was severe on safflowers in 1985 the unusual weather conditions must be taken into consideration. Southwest Manitoba does not normally receive heavy rainfall during

August. In some areas over 25 cm of rain were received in August in 1985. If the growing of safflower is restricted to the traditionally dry southwest region of Manitoba serious disease loss years are likely to be of only occasional occurrence. With the present varieties, growing of safflowers is not recommended in central and eastern Manitoba because of disease and it is not recommended in the northwest region because of the long growing season required by the safflowers.

BLACKLEG - ANOTHER DISEASE PROBLEM FOR CANOLA PRODUCERS IN MANITOBA

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Introduction

Blackleg disease of canola is caused by an ascomycetous fungus called Leptosphaeria maculans, more commonly known by its imperfect form, Phoma lingam. This disease was a serious seed-borne disease of cruciferous vegetable crops, particularly the cabbage, until the advent of systemic seed treatment fungicides, most notably benomyl, which effectively control the disease when the primary source of inoculum is the infected seed.

In the past twenty years or so the development of oilseed rape as a major oilseed crop in the western world has resulted in this disease becoming more important. The very existence of rapeseed as a commercial crop in Australia in the early 1970s depended in large part on the development of cultivars resistant to this pathogen.

Today, blackleg is considered the most serious pathogen of oilseed rapes in many parts of western Europe where resistant cultivars have not been developed or are not used. It is much more difficult to control with chemicals than is Sclerotinia stem rot and can be extremely devastating when the crop is grown in the winter form when infection can occur in the fall and the disease becomes established very early.

In Canada, the disease has been present for many years when rapeseed was a relatively minor crop. Isolates of the pathogen obtained from diseased plants at first appeared to be rather weakly pathogenic and little damage to the crop ensued. However, in 1975, in a few fields in Saskatchewan, a new strain of the pathogen was isolated which was much more virulent on rapeseed and this strain caused serious losses in these fields. Since that time the area of rapeseed production in Saskatchewan from which the virulent strains have been isolated has expanded to include virtually all areas of the province today. In 1983 reports of the virulent strains being isolated from fields in Alberta occurred and in 1984 the virulent strain was isolated from a diseased field near Somerset, Manitoba.

To assess the extent of the area in Manitoba of infestation with the virulent strains we conducted a thorough survey of farmers' fields this year in association with the annual rapeseed disease survey and with some additional surveys in southern Manitoba. The information from these surveys is presented in this report. In addition a review of the symptoms of the disease, the life history of the pathogen, the disease cycle and current control measures is also presented.

Symptoms of the Disease

On the leaf greyish spreading lesions occur which are round to irregular in shape and usually dotted with numerous black pycnidia. Poorly defined white or grey lesions may later be formed on stems often beginning near the base of the scar remaining from a fallen infected leaf. In severely infected plants, the basal portion of the stem is affected by a canker and by the time of full podding stage of the host the stem may be completely girdled. Such plants ripen prematurely and produce shrivelled seed. The pods on these plants have a tendency to shatter before healthy plants are ready to be swathed. Infection by the avirulent strains tend to be later and superficial whereas earlier infection by the virulent pathotypes results often in complete severing of the host at the base of the stem.

Life History of the Pathogen and the Disease Cycle

Leptosphaeria maculans is an ascomycete. It also produces an asexual or imperfect form (Phoma lingam). Little is known about the formation and initiation of the sexual form as it is rather difficult to induce the fungus to produce the sexual stage of the life cycle in culture but recent evidence (Petrie and Lewis 1985) suggests that different mating types occur. In nature the sexual stage begins to be formed on infected rapeseed stems in the fall. The fungus colonizes the stubble and the following spring the ascocarps are formed (pseudothecia) and ascospores are produced. With virulent strains the pseudothecia mature earlier than with weakly virulent strains. Consequently ascospores of the virulent strains are discharged in late spring/early summer whereas the ascospores of the less virulent strains are not released until later in the summer (August). Infection levels and subsequent crop damage are correlated to the time of release of ascospores.

The ascospores are much more significant in the epidemiology of the disease than are the asexual spores (pycnidiospores) as the ascospores are wind-borne, may be dispersed for moderate distances and have a greater inoculum potential than do the pycnidiospores. When the disease is already established in an area the significance of seed-borne infection is also of minor importance in the levels of disease that will occur. Ascospore infection results in a lesion being formed at the infection site. Infections may occur on stems, leaves or pods although pod infection and subsequent seed infection appear to be relatively infrequent. About two weeks after infection the imperfect spore stage of the fungus occurs on the lesion and the fruiting bodies (pycnidia) are easily seen as black dots and these ooze a pinkish mass of pycnidiospores when moist conditions prevail. The dispersal of these spores is dependent on splashing rain so new infections resulting from these spores is either on the same plant or on nearby plants and long distance spread is unlikely.

Pod infections may result in mycelial infection of seed and thus the disease may be spread on contaminated seed. This type of infection is of major epidemiologic significance for long distance dispersal of the pathogen by transportation in infected seed lots. Even low levels of infected seed (less than 0.1%) can establish blackleg in rape crops. A diagrammatic representation of the disease cycle is shown in Figure 1.

Survey of Blackleg Infected Fields 1985

Materials and Methods

Areas of Manitoba Surveyed

In late August and early September surveys of rapeseed fields were made in the areas

1. bounded by Winnipeg, Portage la Prairie, Carman and Morris,
2. from Somerset to Minto and the area south of Brandon
3. the western region of the province from Russell to Swan River,
4. near Dauphin,
5. the interlake region especially around Arborg,
6. east of Winnipeg to Beausejour and south to La Broquerie, Steinbach and St. Pierre.

Fields were sampled either by collecting 25 plants at random if the crop had not yet been swathed as previously described (Rimmer and Platford, 1982) or by thorough searching of the remaining stems in fields which had been cut. Fields where 25 plant samples were obtained were searched for plants showing blackleg symptoms and isolations were made from any plants obtained in this way though these plants were not included for disease level assessment. Isolations from stems showing symptoms of the disease were made and all Phoma lingam isolates obtained were assessed for virulence by cotyledon inoculations of susceptible and resistant cultivars of Brassica napus (Westar, and Cresor) and compared in their reactions to known isolates of the virulent and weakly virulent pathotypes.

Results

The summarized data from the survey are presented in Table 1. Fifty nine fields of B. napus were surveyed and significant levels of blackleg, root rot and Sclerotinia stem rot were observed. Losses province wide due to Sclerotinia sclerotiorum were in the range of about 3%, a figure which might have been much higher but for the fact that many fields were sprayed with fungicides for Sclerotinia control. Blackleg was found predominantly in the areas south of Brandon, less frequent in the area south of Portage la Prairie and from Carman to Minto and also quite abundantly in the western areas of the province around Russell, Roblin and Grandview/Gilbert Plains. Disease incidence of blackleg varied from low levels to 90%. The fields with high levels of disease suffered considerable damage but no estimate of the losses was made. Isolates obtained from these regions were of the virulent pathotype (Table 2).

Discussion

It is now clear that the virulent pathotype of the causal agent of blackleg of canola is established in certain areas of the province. The main regions are the area south of a line from Brandon to Portage with heavy infection in the region of Elgin, Fairfax and Minto and the western portion of the province from Russell to Roblin to Gilbert Plains. It is probable because of the very high levels of disease observed in some fields that the disease has been present for some time. The area of the province near Minto has not been surveyed in recent years and this fact would explain the reason why the disease has not been observed in this area before. In 1984, a virulent isolate of the fungus was obtained from the Somerset area and this year the virulent pathotype was isolated from other fields in this part of the province. Another factor may have been that the weather conditions in 1985 were especially conducive to blackleg disease development. Another point that should be considered is the high degree of susceptibility of the cultivar 'Westar' which now occupies most of the canola acreage in the province.

Disease control

The main control measures for this disease are presented in Table 3. It is important to realize, however, that seed treatments are a measure to prevent the introduction of the pathogen into an area or region and that they are of little value in controlling the disease once it is established in an area or farm.

Crop Rotation. Canola or mustard should not be seeded on stubble or adjacent to a field which had the disease the previous two years. A crop rotation sufficiently long to allow complete decomposition of the rape trash should be used. This will usually require a four year rotation. Burial of canola trash into the soil will assist this process and reduce the inoculum dispersed into the air. Control wild mustard, which also is a host of the disease, and volunteer plants. These plants may be infected and allow the disease to maintain itself during the rotation period.

Seed Treatment. Farmers shoud be very careful to ensure that all seed be treated to help prevent the spread and establishment of the disease into other parts of the province. A number of products are available for this purpose and these are listed in Table 4. Most of these compounds are dual purpose formulations containing fungicides for control of blackleg and seedling blights and lindane for flea beetle control.

Resistance

No cultivars that are currently recommended are resistant to blackleg but the development of resistant cultivars is a high priority in our breeding program at the University of Manitoba. The recommended cultivars of canola are very susceptible.

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TABLE 1. MANITOBA RAPESEED DISEASE SURVEY 1985

	B. napus*		B. campestris	
	DI (%)	DS (%)	DI (%)	DS (%)
ALTERNARIA POD SPOT	14	-	50	-
ASTER YELLOW	17	-	50	-
BLACKLEG	39	13	-	-
ROOT ROT	25	2.7	100	22.5
SCLEROTINIA STEM ROT	51	5.5	50	1.5
STAGHEAD	-	-	-	-
WHITE LEAF SPOT	2	-	-	-

* 59 fields of B. napus & 2 fields of B. campestris surveyed

Fig. 1

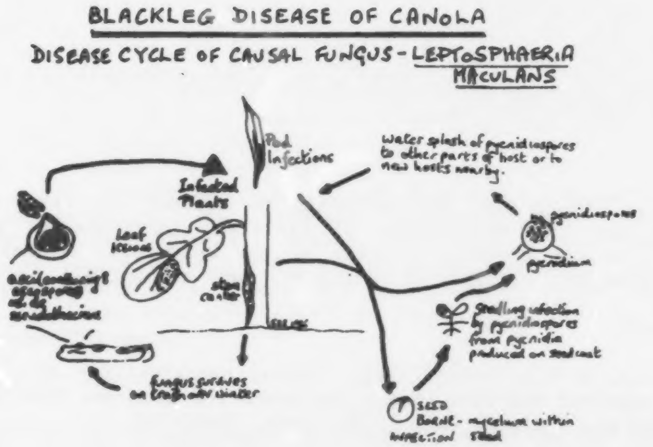
BLACKLEG DISEASE OF CANOLA
DISEASE CYCLE OF CAUSAL FUNGUS - LEPTOSPHAERIA MACULANS
Pod Infections
Infected Plants
Leaf lesions
stem canker
Water splash of pycnidiospores to other parts of host or to new hosts nearby.
pycnidiospores
pycnidium
Seedling infection by pycnidiospores from pycnidia produced on seedcoat
SEED BORNE - mycelium within seed
INFECTION
Fungus survives on trash over winter

TABLE 2: MANITOBA BLACKLEG DISEASE SURVEY 1985

		VIRULENT ISOLATES	AVIRULENT ISOLATES
FIELDS SAMPLED BY SRR AND GP*	23	12	1
FIELDS SAMPLED BY CSP FOODS	10	3	4

*59 fields of B. napus and 2 fields of B. campestris surveyed

TABLE 3. CONTROL MEASURES FOR BLACKLEG (STEM CANKER) OF CANOLA CAUSED BY LEPTOSPHAERIA MACULANS

CROP ROTATION	A MINIMUM OF 3 YEARS SHOULD BE ALLOWED BETWEEN CANOLA PLANTINGS
SEED TREATMENT	A VARIETY OF SEED TREATMENT CHEMICALS ARE AVAILABLE (SEE TABLE 2). THESE WILL NOT BE EFFECTIVE IN PREVENTING THE DISEASE IN LOCATIONS WHERE THE PATHOGEN IS ESTABLISHED
RESISTANCE	RESISTANT CANOLA VARIETIES WILL BE AVAILABLE IN THE FUTURE. AT PRESENT ALL RECOMMENDED VARIETIES ARE SUSCEPTIBLE.

TABLE 4. SEED TREATMENT CHEMICALS FOR CONTROL OF BLACKLEG

PROPRIETARY NAME	ACTIVE INGREDIENT
BENLATE T	BENOMYL
BENO LIN R	BENOMYL
GAMMASAN +	BENOMYL
ROVRAL ST	IPRODIONE
THIRALIN +	BENOMYL
VITAVAX RS	CARBATHIIN

A REVIEW OF SEED-APPLIED PESTICIDES AND COMPATIBILITY WITH RHIZOBIA ON LEGUMES

R.C. Zimmer, Agriculture Canada, Morden, MB

A practice followed in the production of pulse crops such as fababeans, field beans, lentils, peas and soybeans is to apply pesticides (mainly fungicides or fungicide-insecticide combinations) to the seed to protect against seed decay and seedling blight and to apply a rhizobial inoculant to the seed to ensure adequate nodulation and nitrogen fixation. The assumption has been that the pesticides recommended and licensed for use on the seed were compatible with the particular rhizobial strains recommended. Recent research indicates that some seed-applied rhizobia can be harmed by pesticides. The following is a summary of recent research on the compatibility of several pesticides with rhizobia on the seed of several legume crops.

Field Bean. While the fungicides captan, PCNB and thiram were toxic to *Rhizobium phaseoli*, captan was more toxic (2). Thiram showed limited toxicity to *R. phaseoli* while seeds treated with PCNB unexpectedly retained more viable rhizobia per gram of seed that did seed treated with the other fungicides. In field studies at one location nodule number per plant was not affected when thiram or PCNB-treated seeds were inoculated and planted promptly but delay between inoculation and planting did reduce nodulation. At a second location all fungicide treatments lowered nodule number per plant.

Fababean, Lentil and Pea. Seed of fababean, lentil and pea were treated separately with the fungicides captan, thiram and metalaxyl or with the insecticide-fungicide combinations of: diazinon - 15%, lindane - 25%, captan - 15% (DL-PLUS DU); diazinon - 11%, lindane - 16.6% and captan - 33.5% (B-3 DU); and captan - 29.5%, malathion - 0.77% (Evershield SU), and then with seed-applied *Rhizobium leguminosarum* multi-strain inoculant (4). Seedling emergence was not affected detrimentally by pesticide applications, and while most of the pesticides either stimulated or caused minimal detrimental effects on nodulation and nitrogenase activity, captan reduced both in all three legumes. Captan - containing compounds such as B-3 (33.5% captan) and Evershield (29.5% captan) also reduced nodulation or nitrogenase activity in some of these legumes while DL-PLUS (15% captan) was not harmful, which suggests that compounds containing 29.5% captan or higher may not be compatible with seed applied *R. leguminosarum*.

Soybean. The effect of the fungicides: captan (0.8 g), thiram (0.6 g), carboxin (1.1 g), and PCNB (0.9 g), applied to seed on the basis of g/kg seed, on survival of *Rhizobium japonicum* on soybean seed was studied in laboratory growth chamber experiments (1). *R. japonicum* was compatible with thiram, and carboxin but not with captan or PCNB. PCNB reduced *Rhizobium* survival on seed and decreased nodulation. Captan was less toxic to rhizobia than was PCNB, but nodulation was greatly reduced by captan. Carboxin had little effect on viable rhizobia or nodulation when seeds were planted within 4 hours of inoculation; after 24 hours, nodulation was poor despite the presence of adequate viable rhizobia. Thiram caused no adverse effect on viable rhizobia or nodulation even when the seeds were held 24 hours before being planted.

Rhizobia normally die rapidly on the seeds following inoculation; fungicides appear to accelerate this process. Captan and carboxin reduced viable *Rhizobium* about 20% in one hour whereas

PCNB killed 78%. In 4 hours inoculated control seed lost 6% of its viable rhizobia compared to 20% on captan and carboxin-treated seed, and 83% for PCNB-treated seed. Thiram had no adverse affect on rhizobial survival.

Another report (3) compares the effect of seed-applied fungicides: captan, thiram and carbithiin, and herbicides - chloramben, linuron, metribuzin and trifluralin applied preplant incorporated on seed yield, nodulation and N_2 fixation on a soybean variety planted in soil inoculated with granular rhizobial inoculant. None of the fungicides or herbicides affected seed yield, nodulation or N_2 fixation when granular rhizobial inoculant was applied to the soil. The inhibitory effects of captan noted by others on N_2 fixation in soybeans may be due to the more intimate contact between the fungicide and inoculant when the latter is seed-applied.

General Comments. Captan has been considered the best wide-spectrum fungicide for use as a seed protectant on leguminous seed. In the various test results reported on in this short review captan, applied as a seed treatment was deleterious to most rhizobia applied to the seed with one exception; when the concentration of captan was only 15%. Thiram generally was less toxic in most instances and perhaps should be recommended for inoculated pea and lentil. A good practice to follow is to plant rhizobial-inoculated seed treated with a fungicide as soon as possible.

It may be possible to circumvent the toxic effects of captan on seed-applied rhizobia by inoculating with a granular inoculant in soil as has been done for field bean and soybean; at present this is not economically feasible. Granular inoculation of legumes in narrow interrow spacings requires over 28 kg of rhizobial inoculant per hectare (based on the manufacturer's recommendation of 0.57 g inoculant/m). Thus, seed-applied rhizobial inoculants will remain the choice for pea, lentil and fababean. Further research is required to select superior strains of Rhizobia that are tolerant of or resistant to the recommended rate of captan or to identify fungicides that are as effective as captan in protecting the seed and seedling against decay and are tolerated by the rhizobia.

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The Cereal Rusts in Manitoba in 1984 and 1985

J. Chong, D.E. Harder, J.W. Martens and D.J. Samborski

In 1984 wheat leaf rust was first observed on June 25. This was followed by oat crown rust and oat stem rust about mid-July. By this time, wheat stem rust was already common in eastern and central Manitoba. However, none of the rusts developed rapidly because of the prevalent hot dry conditions. Except for Norstar winter wheat which had infections up to 80% at the end of the growing season, the diseases caused little damage to wheat and oat crops in 1984.

In 1985 the inocula of all rusts arrived early. Wheat leaf rust was first observed on June 14 in fields of Norstar near Carman and Thornhill. This was followed by wheat and oat stem rusts around July 10. By mid-July, both crown rust and stem rust of oats were quite common in southern Manitoba. Because of the very early appearance of the rusts, it was anticipated that heavy infections on susceptible cultivars would follow. However, weather conditions were too cool and dry to allow good rust development; even winter wheat escaped damage in 1985. With the oats, a second factor is the increased cultivation of resistant cultivars. In 1985 about 81% of the area seeded to oats in Manitoba comprised the cultivars Fidler and Dumont, which are resistant to both oat crown rust and oat stem rust. This trend should continue with the introduction of Riel oats.

There were no important changes in wheat leaf rust races in both 1984 and 1985. A number of cultures isolated from collections made in Manitoba in 1984 attacked Benito, while Columbus was moderately susceptible to other isolates. Collections made in 1985 yielded very few cultures that could attack either of these cultivars.

With the wheat stem rust, twelve races, including four new ones, were identified in 1984, but none of these were virulent on the commercial spring wheats grown in Manitoba. Race C53, dominant since 1977, was the prevalent race in Manitoba in both 1984 and 1985.

The physiologic races of both oat crown rust and oat stem rust have not changed greatly in recent years, and currently do not pose a threat to the resistant cultivars. However, single-gene mutations could results in virulent races, and the rust populations are continuously monitored to detect early changes that may affect the oat breeding program.

HEALTH PROTECTION BRANCH MONITORING AND INVESTIGATIVE PROGRAMMES FOR MYCOTOXINS IN WESTERN WHEAT

A.S. WILL

I would like to begin by telling you what I am going to tell you and what I am not going to tell you.

First I would like to define what it is we are concerned about, then, why we are concerned, and finally what we are doing from a sampling viewpoint in Manitoba and Saskatchewan.

As I am neither a mycologist nor a toxicologist, I will not delve too deeply into either subject but just repeat enough of what I have read to set the stage. Nor will I say anything about the sampling programs which have been carried out by HPB in Ontario and Quebec.

The term mycotoxin is used to cover a wide range of chemical substances produced by moulds in the course of their normal pursuit of life. A number of these compounds were first studied as potential antibiotics in the early 1930's and 1940's. They were discarded as being too toxic to higher life forms to be of value in treating disease. At that time, the potential health problems that these compounds might pose as contaminants of the food supply were not recognized.

The field of mycotoxins received very little attention until 1960. In that year, a severe toxic outbreak occurred in turkey poults in England. The cause was traced to a feed component, peanut meal, which was heavily infested with the common storage mould _Aspergillis flauus_. The isolated toxic principle was named "Aflatoxin". The toxicity of the aflatoxins vary according to the target species, dosage, and duration of exposure. Response also varies between individuals of a given species. This variation in response is a point of concern with all mycotoxins and for HPB especially how to relate animal responses to possible human responses.

Most foods are susceptible to fungal invasion at some stage of production, processing, transport, or storage. If mould growth occurs, there is always the possibility of mycotoxin production. However, the presence of toxigenic moulds in a food product does not automatically mean the presence of mycotoxins but rather that a potential for contamination exists. On the other hand, the absence of toxigenic moulds does not guarantee freedom from mycotoxins, since the toxins may persist long after the moulds have disappeared.

In the case of wheat, we are concerned with a group of mycotoxins known as tricothecenes produced by a number of genera. Of most practical importance, are those synthesized by various _Fusarium_ spp. The tricothecenes as a group exhibited cytotoxic, phytotoxic, antifungal, and insecticidal activity. On a molecular level, the tricothocenes act as potent inhibitors of protein and DNA synthesis. The exact mode of action of vomitoxin has not been determined. In humans and animals tricothecenes can cause severe dermatitis, vomitting, bloody diarrhea, decreased weight, extensive hemorrhaging, and death.

Vomitoxin or deoxynivalenol appears to be the major tricothecene of concern in North America, perhaps because it is produced by an ubiquitus mould - Fusarium graminearum. It was first isolated in 1975 from Japanese barley. Subsequently, it was obtained from Fusarium - contaminated corn in the United States.

Vomitoxin has been shown experimentally to be a powerful emetic agent in swine, dogs and ducklings; to cause feed refusal in swine and rats; and to show embryotoxicity in mice. Very little is known of its effects on humans. The widespread natural occurrence of vomitoxin in grains (corn, barley and wheat) in many parts of the world is cause for concern from the viewpoint of both animal and human health.

The growth of Fusarium moulds producing vomitoxin is favoured by cool (an average temperature of about 20°C), wet weather conditions which have been prevalent in the Red River Valley for the past several years. The mould infects the wheat during heading and results in a shrivelled, pale kernel termed a Tombstone kernel, often with a pronounced pink colouration.

Unfortunately, this characteristic defermation does not correlate to vomitoxin contamination, in that the toxin may be present in samples not exhibiting tombstone kernels.

Concern about mycotoxins is widespread:

Farmers - reduced yields and downgrading.

Food producers - effects on food products
- non-availability of grain products i.e. flour as in 1980 when Ontario soft winter wheat was prohibited in the processing of infant foods and Quebec red spring and utility hard wheats were prohibited in the production of human food.

Feed manufacturers - liability for use in feeds and subsequent illness in animals.

Livestock producers - reduced yields, loss of animals.

Consumers - effects of mycotoxins in foods either;
direct - in grain based foods ,
indirect - in meat, milk, eggs from animals fed contaminated grain.

Grain handlers - health hazards in handling grain and in dust.

Health Protection Branch is concerned about vomitoxin in grain because:

a. Fusarium graminearum is common in nature.
b. Grain and grain products are a major part of the Canadian diet.
c. The effects on humans is largely unknown.
d. Some related mycotoxins are highly toxic to humans.

It was for these reasons that HPB became involved in 1980 when Eastern soft wheats were found to be contaminated. Of major concern was the use of soft wheat in flour in infant foods. The first indication of a problem was the unusually high incidence of Fusarium-infected pink kernels in the wheat crop. Because there was very little toxicological data available, an evaluation was carried out based on extrapolated data for T-2 toxin.

In order to set guidelines for vomitoxin in Eastern wheat, which is normally blended with Western wheat before milling, it was necessary to determine levels in Western wheat. To this end, Plant Products, Agriculture Canada, Inspection Branch, Canadian Grain Commission; and Health Protection Branch co-operated to obtain and analyze wheat from across the prairie provinces. This sampling was intended to give a broad picture of the western wheat crop as delivered to country elevators. It covered only wheat intended for human consumption.

The Canadian Grain Commission selected the elevators and provided instructions, sample bags and tags to the grain companies; Agriculture Canada field inspectors picked up the samples and delivered them to the nearest Health Protection Branch office; HPB completed the data entry forms and carried out the analyses.

For the five years 1980 through 1984, this general screening found the crops free of vomitoxin. In 1985 as well, except for the Red River Valley, the crop was free of vomitoxin. Tombstone kernels have not been reported outside the valley.

In December 1984, a farmer in the Letellier area noticed some unusual kernels in his wheat and submitted a sample to his local elevator agent. The Canadian Grain Commission Laboratory identified the unusual kernels as Tombstone kernels and found levels of 12.6 and 9.6 ppm vomitoxin in the wheat.

During the week of December 17, 1984, HPB collected samples from grain elevators in 32 Red River Valley communities and from six farms in the vicinity of the original discovery. Each sample was split between HPB and CGC. Three of six farms yielded one or more samples containing vomitoxin in an amount exceeding 0.10 ppm. One farm was free of vomitoxin.

Three specimens were obtained from each elevator in each town. Levels exceeding 0.10 ppm were found in single samples from Domain, Homewood, Elm Creek, Carey, Letellier, McTavish, Fredensthal, Sanford and Brunkild; only one exceeding 0.20 ppm. Three specimens from Sperling contained 0.10 ppm or more. Non-detectable levels were also observed in other samples from these areas. Only wheat from the original incident was considered to be of concern. Disposal was left in the hands of the Canadian Grain Commission.

In February 1985, it was decided to obtain specimens of wheat from Northeastern Saskatchewan where high moisture conditions had prevailed for several years. Single samples were obtained from ten farms. No signficant levels of vomitoxin were found in any of the samples.

Plans were made for sampling the 1985 crop in August and September 1985 calling for forty specimens from the Red River Valley (Elevators 30; farms in the Letellier area - 10), twenty-five from the rest of Manitoba and twenty-five from Saskatchewan. Sampling in the Valley was to be done by HPB inspectors and the remainder of Manitoba and Saskatchewan, as in previous years, in co-operation with Agriculture Canada and the Canadian Grain Commission.

This plan, at least for Manitoba and the Red River Valley, to quote the data processors, "crashed" in the third week of August. The Grain Commission reported tombstone kernels in wheat from the Winkler area and rumours of affected grain in Plum Coulee, St. Jean, Morris and Morden. Their laboratory had confirmed vomitoxin in two specimens from Winkler (0.4 and 0.8 ppm) and one from Homewood (1.3 ppm). Elevator agents were advised not to accept any grain with evidence of blight. As a result, HPB inspectors began farm level sampling on August 29, 1985. The weather-delayed harvest made it difficult to obtain samples and many kilometers were driven just finding farmers who had succeeded in getting on the fields. A total of 56 samples were obtained by September 4, 1985. Agriculture Canada agreed to carry outthe sampling in the rest of Manitoba, adding samples from the Interlake Region. HPB obtained samples from the Northwest corner of the province. None of the samples from outside the Red River Valley showed any significant amount of vomitoxin.

In addition, with the assistance of the Manitoba Department of Agriculture and Agriculture representatives in the field, samples of wheat grown on fields upon which corn had been grown in 1984 were obtained. This was done because of the experience in southern Ontario which indicated that over-wintered debris from infected corn can result in damage to subsequent crops. The analytical results show that vomitoxin is more prevalent under these conditions and that maximum amounts are higher.

A portion of each sample, including those from corn fields, was sent to CGC's Grain Inspection laboratory where it was examined for tombstone kernels and graded. Advice was provided to growers on the disposal of downgraded samples.

Samples obtained by Agriculture Canada were analyzed by their Ottawa laboratories.

A further sammpling of 1985 wheat in the Red River Valley is planned for December 1985. This will be limited to single samples from ten elevators and will provide some data on the condition of wheat in storage. This will give some indication of the validity of current guidelines for eastern wheats to be blended with western wheat.

The Health Protection Branch guideline limit for uncleaned soft wheat to be used in non-staple foods as established in May 1983 is 2.0 ppm. If, however, the wheat is intended for use in the processing of infant foods, the maximum acceptable level is 1.0 ppm. Our data indicates that cleaning, milling, and processing will reduce these maximum levels to 1.2 ppm and 0.6 ppm respectively in the flour portion of the finished products. These levels are also applicable to soft wheat to be used in the production of bran.

The acceptable guideline level for wheat grown in Eastern Canada, for use in staple foods is 0.50 ppm. This is applicable to the final blend of wheat after cleaning and before processing.

No maximum acceptable guideline has been established for Western hard wheats.

I am sure that I need say little to this group about the importance and value of western wheat to Canadians as a major part of their diet, and as a corner stone of the nation's economy. It was and is, therefore, vital that all those agencies who have an interest in wheat and its products, co-operate fully to resolve the problem.

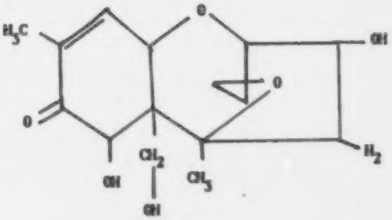
This, in fact, is what has happened over the last six years. The co-operative effort in sampling by Plant Products, Grain Inspection and HPB provided the basic team which tackled the problem in the Red River Valley. The team expanded in 1984/1985 to include the Grain Research Laboratory and the Manitoba Department of Agriculture. Responsibility for wheat and its products does not reside in any oneagency. Each has a part to do and each affects the others.

Fusarium graminearum is not likely to change its lifestyle nor move off the Prairies and so we can expect to have the spectre of vomitoxin with us forever. It is a new problem and we should expect that research and experience will enable us to deal with the hazard as we do with orgot, aflatoxin and other naturally occurring hazards. The solution will undoubtedly include agricultural practices, grain inspection, monitoring and investigative sampling programs, and co-operative problem solving.

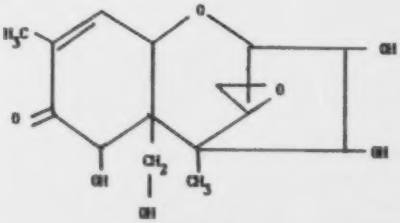
TOXICOLOGICAL CHARACTERISTICS OF TRICOTHECENE TOXICOSIS

1. VOMITTING, TACHYCARDIA, DIARRHEA
2. HEMORRHAGING, EDEMA, NECROSIS OF SKIN TISSUE
3. HEMORRHAGING OF THE MUCOSAL EPITHELIA OF THE STOMACH, LUNGS, AND INTESTINE
4. DESTRUCTION OF HAEMATOPOIETIC TISSUE
5. DECREASE IN CIRCULATING WHITE BLOOD CELLS AND PLATELETS
6. MENINGEAL HEMORRHAGE IN THE BRAIN
7. NERVOUS DISORDER
8. REFUSAL OF CONTAMINATED FEED

CHEMICAL STRUCTURE



DEOXYNIVALENOL
(VOMITOXIN)



NIVALENOL

LD_{50} OF SELECTED TRICOTHECENES
mg / kg

TOXIN	RAT	TROUT	CHICKEN	MOUSE
FUSARENON-X				3.3
NIVALENOL				4.1
VOMITOXIN				50.0
T-2	3.8	6.1	0.6	5.2
HT-2				9.0
DIACETOXYSCIRPENOL				23.0
TRICHOTHECIN				<250

PLANNED MONITORING SAMPLING
WESTERN WHEAT
1980 - 1985

NUMBER OF SPECIMENS

PROVINCE	1980	1981	1982	1983	1984	1985
ALBERTA	21	19	60	35	35	35
SASKATCHEWAN	39	27	65	25	25	25
MANITOBA	25	14	10	15	15	25
RED RIVER VALLEY	-	-	-	-	-	40
TOTAL	85	60	135	75	75	125

DECEMBER 1984
INVESTIGATIVE SAMPLING
RED RIVER VALLEY

VOMITOXIN PPM

NO. SPECIMENS	≥0.05		≥0.10		≥0.5	
	NO.	%	NO.	%	NO.	%
129	35	27.1	15	11.6	0	

SUMMARY
1985 WHEAT SAMPLING

VOMITOXIN PPM

SOURCE	NO. SPECIMENS	≥0.5		≥0.10		≥0.50		≥1.00	
		NO.	%	NO.	%	NO.	%	NO.	%
RED RIVER VALLEY	74	19	25.7	10	13.5	4	5.4	2	2.7
OTHER MANITOBA	40	0		0		0		0	
TOTAL MANITOBA	114	19	16.7	10	8.9	4	3.5	2	1.8
SASKATCHEWAN	26	0		0		0		0	

1985 WHEAT GROWN ON CORN STUBBLE

VOMITOXIN PPM

NO. SPECIMENS	>0.05		≥0.10		≥0.50		≥1.00	
	NO.	%	NO.	%	NO.	%	NO.	%
22	11	50.0	10	45.5	5	22.7	3	13.6

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HERBICIDE SELECTIVITY IN FIELD PEA

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Selectivity: A Definition.

Selectivity is found to varying degrees by herbicides and refers to the differential response which results to plant species following herbicide application. Herbicide selectivity allows the application of a herbicide to permit the unhindered growth of a crop while the potentially competitive weeds show susceptibility. The manipulation or control of weed growth in many crops, including field peas is agronomically desirable in terms of maintaining crop yield, consistency in quality and ease of harvesting. While the basic concept of herbicide selectivity is something which is easy to take for granted, the mechanisms responsible (biological and chemical) are often difficult to examine and poorly understood. Before examining the mechanism of herbicide selectivity in field pea it is appropriate to initially consider the desirability of achieving weed control via selective herbicides.

The Desirability of Achieving Weed Control in Field Pea.

Manitoba is recognised as the Canadian Province which is foremost in the production of field peas. As a legume crop, field pea is planted annually in some 45,000 hectares in Manitoba and ranks second in area only to alfalfa. Similar to many other non-cereal crops extensive studies on the effects of specific weed populations on the yield of peas have not been carried out. Early studies by Nelson and Nylund (1962) showed the general nature of competition for light and moisture effected by various densities of mustard and foxtail. When present with the pea crop during the first 10 weeks of growth, 3 mustard plants per 0.1 m^2 was equal in effect to 27 foxtail plants. In summary, yield reductions of the order of 64% were recorded as a consequence of mustard competition. The potentially severe competitive effects of mustard described by Nelson and Nylund (1962) can be contrasted with the less competitive quackgrass (Agropyron repens) L. Beauv. described by Proctor (1972).

A particularly comprehensive investigation of competition between annual weeds and field peas was carried out by Lawson (1982). At target crop population densities between 11 and 194 plants/m^2, Lawson (1982), showed impaired vegetative development, particularly by reducing tillering in low density crops. Reduction in the number of pods per plant was the only significant component of yield to be reduced. Weeds had no effect on the numbers or weights of peas in full pods. Adverse effects of weeds on the growth of peas decreased with increased crop density. Higher density crops suppressed weeds very effectively but were no less vulnerable to yield loss than those of lower density. Thus crops sown at higher densities merit just as much attention to effective weed control as crops suffering more visibly from competition by weeds.

Factors which may influence selectivity of herbicides.

It is convenient to examine separately some of the factors which influence the selectivity of a herbicide when applied to field peas; these include a) crop morphology, b) herbicide retention, c) herbicide placement, d) formulation of the herbicide.

a) Crop morphology

The field pea germinates, grows and develops a crop canopy influenced by temperature, water availability and light particular to a specific field, season and to the cultivar. Perhaps one of the most significant variations in morphology of the field pea has been the introduction of pea genotypes with reduced stipule size and the substitution of tendrils for leaflets (Snoad, 1974). Plants of this type are described as leafless. The objective in undertaking the production of leafless and semileafless field peas (as per cv. Tipu) is mainly to improve the standing performance of the crop. Lodging can be regarded as being one of the potential major losses, up to 80% (Davies, 1977 cited by Medley and Ambrose, 1981).

It has been recognised for some time that the pea crop can be quite sensitive to the foliage application of herbicides especially when treated in the late seedling stage. Herbicide retained on the broad leaves and in the pockets where stipule meets stem can be localised areas of high herbicide concentration, resulting in crop scorch. The leaves themselves may be insufficiently waxed and the only safe and rapid way of assessing waxiness is using the crystal violet test (Anon, 1978). Generally it is safe to spray when less than 10% of a 1% crystal violet solution is retained on the lower leaf surfaces.

Leafless and semileafless peas may provide a less receptive surface to the application of a foliage-applied herbicide. In practice however, using a wide range of herbicides King and Knott (1979) reported little difference in tolerance of conventional vs leafless pea cultivars to most foliage-applied herbicides. Treatments which contained MCPB only or MCPB mixed with cyanazine or bentazon mixed with MCPB caused phytotoxicity. These authors suggested that attaining weed control in leafless peas was more difficult than in conventional cultivars possibly due to the lack of shading caused by the open crop canopy. There was little difference in the requirement for or success of weed control in semi leafless vs conventional cultivars.

b) Herbicide retention

Almost 30 years have passed since Blackman, Bruce and Holly (1958) investigated the relationship between herbicide retention and selective toxicity. These authors demonstrated the subtle changes which can occur in herbicide retention as it applied to the pea plant. An increase in spray volume, the reduction of spray surface tension and development of the pea plant all tend to increase the total amount of spray retained per plant. Not only does herbicide retention influence the relative tolerance of a pea cultivar to the application of that herbicide but it also can have a influence on the susceptibility of different weeds. Thus the ultimate formulation and application technique recommended for a particular herbicide will represent a practical compromise; providing consistency of weed control together with crop tolerance. It is clear that while retention can play a major role in determining crop tolerance and herbicide efficiency of control the importance of this factor varies within and between contact and foliage-applied translocated herbicides. In the extreme, herbicide retention may have little or no influence on herbicide activity. This is exemplified by the first generation graminicide alloxydim sodium where Veerasekaran and Catchpole (1982) showed that retention, generally greater for broad leaved crops (cotton, sugarbeet, flax, beans and peas) than for wild oats, barley and quackgrass did not contribute between susceptible and tolerant species.

c) Herbicide placement

In the pea crop positional selectivity or depth protection can be used, sometimes in conjunction with differential retention and/or herbicide uptake to confer crop tolerance with effective weed control. The large seeded pea is planted at depth in the soil thereby below the soil surface which will subsequently receive a post-emergence treatment of a soil applied residual herbicide such as a triazine, cyanazine or metribuzin. Typically the triazine herbicides are readily absorbed by the roots of developing weeds. The herbicide moves only in an upward fashion in the transpiration stream. Thus under very dry soil conditions, uptake via roots may be limited. Within tolerant species (peas) the triazines are metabolized or detoxified to a much greater extent than in susceptible weed species. In practice the triazines are applied as post emergence sprays in an attempt to control young weed seedlings and subsequently prevent the establishment of potential weed growth from seeds.

In another herbicide family the dinitroanilines, trifluralin is a soil applied and incorporated treatment which will be in intimate contact with the developing pea root. Herbicide placement does not influence the tolerance of field peas to trifluralin. Rather, the inherent moderate resistance of the crop to the inhibitory effects of trifluralin on root growth permits normal growth while susceptible species such as green foxtail and red root pigweed are controlled.

d) Herbicide formulation

Herbicide recommendations are normally the product of much field and laboratory investigation. Such recommendations are designed to provide effective weed control with a range of crop cultivars and a range of weed species. Adjustments may be recommended in herbicide rate to provide adequate crop safety under field conditions, subject to the vagaries of climate, soil type and crop production techniques. Often when moves are made away from the recommended treatments then crop tolerance problems can result. Alteration of the existing herbicide formulation via the mixing of herbicides can have a profound effect on herbicide selectivity.

With the development of new selective graminicides such as sethoxydim and fluazifop-butyl it is desirable to consider the possibility of controlling broadleaved and grass weeds as one operation perhaps via herbicide tank-mixing. One of the problems is that while the graminicides generally require high concentrations of oil-based surfactants to provide herbicide activity at low rates, this surfactant may have significant effects on the activity of the broadleaved herbicide in a mixture. The addition of such spray additives in tank mixes with triazine herbicides can increase toxicity via increased herbicide absorption. In field trials carried out at the University of Manitoba (Portage la Prairie) during 1985 phytotoxicity to field peas (cultivars Century and Tipu) was increased by mixing either cyanazine or metribuzin with a graminicide plus surfactant or surfactant alone (1% v/v Assist or 0.5% v/v Canplus). Field peas, a crop which shows marginal tolerance to many herbicides has previously been shown to be susceptible to phytotoxicity where graminicides are used in oil-based surfactants (Knott, 1980).

Conclusions.

It is clear that if the competitive effects of grass and broad-leaved weeds are to be minimised in field peas then herbicide activity and selectivity are required. Within the context of competition the interference effects caused by weed growth has been investigated to a very limited extent. Somewhat contradictory information can be found in the literature when studies examine the competitive effects of weeds in the pea crop. The morphology, growth rate and population density of the crop interacts with the time of emergence, species present and density of the weed population. At present while it is possible to achieve some degree of weed control in peas using selective herbicides the degree of crop tolerance is often unacceptably low.

Thus the value of using selective herbicides to control weed growth and thereby reduce the competitive effects upon final crop yield is not always easy to assess. While weed growth competes with crops for space, light, soil moisture and nutrients it is perhaps of equivalent importance to control weeds due to potential harvesting problems. During a particularly late and damp harvest season such as 1985 it was apparent to many growers that the burden of vegetative weed growth had ultimately to be reduced by chemical desiccation to allow crop drying and harvest. The introduction of semi-leafless or leafless pea cultivars may be of major agronomic value; improved standing ability, uniformity of ripening, less pathogen attack and easier drying. The desirability of achieving selective weed control may require further investigation due to the lack of weed shading effected by the open canopy leafless cultivars. The challenge remains therefore to direct research effort into (1) defining methods to improve selectivity in existing herbicides (2) continuing to monitor the performance of new or previously untested herbicides and (3) genetically engineer herbicide tolerance in field pea cultivars.

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ROUND-LEAVED MALLOW (Malva rotundifolia L.)

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Description. Round-leaved mallow (Malva rotundifolia L.) is an annual weed which has become quite a serious problem in agricultural fields. Seedlings of round-leaved mallow possess two distinct heart shaped cotyledons. The cotyledons, which are prominently veined, have an extremely glossy appearance. Seedlings are produced anywhere from May up till the soil is frozen.

The stem of round-leaved mallow is usually prostrate, and has been reported to grow up to 100 cm in length. In competition situations mallow tends to grow erect, up to a height of 150 cm. The stem of round-leaved is highly branched with many leaves. A mature plant may produce up to 250 leaves. The leaves are round with lobed margins, resembling leaves of a geranium. Mallow possesses an extremely long tap root. Flowers are quite small, and located at the bases of the petioles. The flowers are white to light blue in colour. Seeds are normally found enclosed within a capsule. The seeds of this weed are light grey to black in colour, and arranged within the calyx bracts. Seeds of mallow may remain dormant for many years in the soil due to the thick hard tests.

Current Status in Manitoba. Traditionally mallow has been considered a weed of farmyards and waste places. However, within the province of Manitoba there are reports of increased abundance and distribution of round-leaved mallow (Manitoba Agriculture, Personal Communication). At the present time severe infestations have been noted in South Western Manitoba and Central Manitoba. The occurrence of round-leaved mallow often appears to be associated with situations where farm yard manure is applied to arable fields, or where pastures are cultivated and arable crops planted.

Current Research. Information regarding the biology and control of round-leaved mallow in Manitoba is not available. It is important to gain an understanding of the biology of a troublesome weed to develop a longer term weed control program.

It is necessary to understand:

(1) Germination - as influenced by the environment.
(2) Early seedling growth - as it influences competition with the crop.
(3) Reproductive capacity - seed production and carryover.
(4) Susceptibility of the weed at different stages to chemical/cultural control.

Studies carried out at the University of Manitoba during 1985 examined:

(a) The growth of round-leaved mallow without interference from crop competition in large pots grown outdoors.
(b) The growth of natural infestations of round-leaved mallow in a wheat and a flax field located near Manitou, Manitoba.

(a) Pot Studies:

The pattern of growth and development of round-leaved mallow was examined using mathematical growth analysis techniques. The production of dry matter in various plant structures, leaves, roots, flowers, seeds, stems and petioles, was assessed using destructive sampling at weekly intervals, extending over a period of ten weeks.

The areas (cm^2) of photosynthetic structures (leaves and stems) were also measured using a Delta T leaf area meter. It is therefore possible to assess the growth rates of the different plant organs over time. This data coupled with recording the pattern of growth and development of plant structures provides a picture of the dynamics of growth.

Round-leaved mallow was characterised by:

1) Rapid establishment and growth of a root system.
2) Concurrent production of leaves with root growth (within 14 days of emergence the plants were in the 6-leaf stage).
3) The stems and petioles accounted for equivalent amounts of dry matter production to the leaf dry matter for the first 5 weeks.
4) While the ultimate growth rates of the stems and petioles were lower than those recorded for the leaves, the prolonged duration of growth resulted in a larger total dry matter production in the stems and petioles.
5) The stems have an important role in providing the flower buds. This is reflected in the abundance and total dry weight allocation to the reproductive structures. Fruit dry weight accounted for 54% of the final biomass.
6) Fruits produced by round-leaved mallow bear from 8-12 seeds, thus on the average one plant may produce from 1500-2300 seeds.

(b) Field Studies

Similar to the pot studies, growth analysis techniques were used to assess the nature of competition between round-leaved mallow and a wheat and a flax crop.

Wheat Field:

Assessments were made in 3 replicate (5mx5m) plots to count the number of mallow plants/m^2 and the total dry weight/m^2, where; the farmer applied bromoxynil and MCPA (0.28 + 0.28 kg a.i./ha) for broad-leaved weed control. Similar assessments were made in adjacent plots where no herbicide was applied. Separate hand weeded plots, both herbicide treated and untreated, allowed wheat to grow without the competitive influence of round-leaved mallow.

In the presence of 65 mallow plants/m^2 the total plant dry weight of wheat was reduced from 261 g/m^2 to 212 g/m^2 (19%). The grain yield of the wheat was reduced from 6.69 g/m^2 to 5.21 g/m^2 (21%).

In the same field where herbicide (bromoxynil and MCPA) was applied, 28 mallow plants/m^2, reduced the total plant dry weight of wheat from 258 g/m^2 to 230 g/m^2 (11%).

Flax Field:

Assessments were made in 3 replicate (5mx5m) plots to count the number of mallow plants/m^2 and total dry weight /m^2 where; the farmer applied bromoxynil and MCPA (0.28 + 0.28 kg a.i./ha) for broad-leaved weed control. Similar assessments were made in adjacent plots where no herbicide was applied. Separate hand weeded plots, both herbicide treated and untreated, allowed flax to grow without the competitive influence of round-leaved mallow.

In the presence of 39 mallow plants/m^2 the total plant dry weight of flax was reduced from 114 g/m^2 to 12 g/m^2 (89%). The yield of the flax was reduced from 1.48 g/m^2 to 0.04 g/plant (97%).

In the same field where herbicide (bromoxynil and MCPA) was applied, 44 mallow plants/m^2 reduced the total plant dry weight of flax/m^2 from 111 g/m^2 to 21 g/m^2 (81%).

Conclusion. Since the study was based on two separate fields, with different populations of mallow, the data cannot legitimately be compared. There are striking results obtained in both the flax and wheat fields.

Clearly wheat was a strong competitor with round-leaved mallow. The competitive influence of the crop can play an important part in modifying the success of herbicide control on round-leaved mallow, since weed populations were reduced and crop final yield maintained.

Flax, in this heavy infestation of round-leaved mallow (39 plants/m^2) could not withstand competition. Crop yield was reduced to the extent that there was no commercial value in harvesting this crop. Application of MCPA and bromoxynil gave only transient control, and weed populations were not controlled over time.

Future Studies.

(1) Pot studies will be repeated to carry out further growth analysis studies.
(2) More information will be collected on the effects of mallow on different crops.
(3) The preliminary activity of selected herbicides on round-leaved mallow will be examined.

WILD MUSTARD CONTROL IN SUNFLOWERS - A RESEARCH UPDATE

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Wild mustard (Sinapis arvensis L.) continues to be a serious weed problem in Manitoba sunflower fields. An infestation of 13 wild mustard plants/m of row can reduce sunflower yields by 35% (1, 3). The only herbicides registered for the control of wild mustard in sunflowers are chloramben (Amiben) applied preplant incorporated, and metribuzin (Sencor) applied pre-emergence and harrowed. Seedbed disturbance, spotty mustard control and relatively high cost, have resulted in grower resistance to the use of chloramben (2). Metribuzin was registered in 1983 and entered in the 1984 "Guide to Chemical Weed Control, Agdex 641". The performance of this product has, however, not met expectations, and the recommendation has since been withdrawn (4).

More recent research has identified bifenox (Modown) and desmedipham (Betanex) as potential herbicides for wild mustard control in sunflowers. A research update on these herbicides was presented to this Conference in 1983. These products have not been registered in Canada for use in sunflowers, but it is suspected that at least some growers are using desmedipham with reasonably good results.

Another herbicide mentioned in 1983 was R-40244. This product has since been given the common name of fluorochloridone and the trade name Racer™. This herbicide continues to show promise for the control of wild mustard, and several other broadleaf weeds, in sunflowers. Pre-emergence surface applications at rates of 0.4 to 0.5 kg (ai)/ha have been particularly effective. Data from the Morden Research Station are presented in Tables 1 and 2. Post-emergence applications of 0.05 to 0.10 kg/ha are also effective but some sunflower injury has been noted. Preplant soil incorporated treatments, although effective, require at least 0.75 to 1.0 kg/ha (about 10X the post-emergence rates). Fluorochloridone also controls stinkweed and possibly other Cruciferae species. For broad spectrum weed control, fluorochloridone can be surface applied after a PPI-S or PPI-F treatment of trifluralin or EPTC; or prior to a post-emergence application of a grass specific herbicide (Table 3). At this time, the writer does not know the anticipated time frame for the registration of this product in Canada.

Two other experimental herbicides should be mentioned at this time, EL107 and AC 222293. EL107 (from Elanco) is active as a PPI-Spring or PPI-Fall treatment. At rates of 0.100 to 0.125 kg/ha, it has provided consistent control of wild mustard in experiments at the Morden Research Station (Tables 4-5). It appears to be an ideal adjunct to trifluralin or ethalfleruralin for broad spectrum weed control.

Racer Trade Mark of Stauffer Chemical Co.

AC222239 (from Cyanamid) is a selective post-emergence herbicide that controls wild mustard, wild oats, stinkweed and wild buckwheat. In our trials, it has shown no control of green foxtail, lamb's-quarters or redroot pigweed. Tolerance to sunflowers has been excellent and effective rates are 0.25 to 0.50 kg/ha (Table 6).

The three herbicides discussed in this paper offer considerable promise for wild mustard control in sunflowers. It it hoped that at least one of these will be registered by Agriculture Canada for use in sunflower in the near future.

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Table 1. Fluorochloridone on I-894 Sunflowers, 1984.

Treatment	When Applied	Rates kg (ai)/ha	Wild Mustard Control % ground cover	Crop Tolerance (0-9)	Crop Yield g/m^2
Weedy	-	-	35	9	61 d
Weeded	-	-	0	9	197 a
Fluorochloridone	PPI	1.0	4	9	185 ab
Fluorochloridone + Treflan	PPI	0.56 + 1.0	10	8.5	130 c
Fluorochloridone + EPTC	PPI	0.56 + 3.0	8	9	191 a
Fluorochloridone	PRE-S	0.42	0	8.5	211 a
Fluorochloridone	PRE-S	0.56	0	8	188 a
Fluorochloridone	PRE-S	1.12	0	8	204 a
Fluorochloridone	POST *	0.06	5	8	190 a
Fluorochloridone	POST *	0.12	4	7.5	216 a

* Post = 4-leaf stage

DMRT (5%)

Table 2. Fluorochloridone on Sun M20 Sunflowers, 1985.

Fluorochloridone		Weed Control			
Rates kg(ai)/ha	When Applied	Wild Mustard	Stink-weed	Crop Tolerance	Crop Yield
		-- % ground cover --		(0-9)	g/m^2
—— Weedy ——		9	23	9	141 c
—— Weeded ——		2	3	9	180 ab
0.50	PPI	7	4	9	167 ab
0.75	PPI	2	2	9	160 abc
1.00	PPI	4	2	9	171 abc
0.50	PRE-S	3	2	9	172 ab
0.75	PRE-S	0	0	9	184 a
1.00	PRE-S	0	0	9	166 ab
0.05	Early Post *	3	4	7	169 ab
0.10	Early Post	1	0	6	173 ab
0.20	Early Post	0	1	6	178 ab

* Early Post = 2-leaf stage

DMRT (5%)

Table 3. Fluorochloridone/other herbicides on Sun M20 Sunflowers, 1985.

Herbicides	Rates kg(ai)/ha	When Applied	Weed Control** WM	WO	GF	Crop Yield *
			% Ground Cover			g/m^2
Weedy	-	-	17	45	6	78 b
Weeded			1	1	1	160 a
EPTC + Fluorochloridone	2.25+0.56	PPI	5	25	1	154 a
Trifluralin + Fluorochloridone	0.75+0.56	PPI	2	21	2	163 a
Trifluralin/Flurorchloridone	0.75/0.42	PPI/PRE-S	1	19	3	162 a
Trifluralin/Flurorchloridone	0.75/0.56	PPI/PRE-S	0	22	1	167 a
EPTC/Fluorochloridone	2.25/0.42	PPI/PRE-S	1	14	4	170 a
EPTC/Fluorochloridone	2.25/0.56	PPI/PRE-S	1	17	3	169 a
Fluorochloridone/Sethoxydim	0.56/0.3	PRE-S/POST	1	0	4	165 a
Fluorochloridone/Sethoxydim	1.12/0.3	PRE-S/POST	0	2	2	162 a

* Crop Tolerance = 9 for all treatments

** WM = Wild mustard, WO = Wild oats, GF = green foxtail

Table 4. EL 107 PPI-F on Sunflowers*, 1984-85.

Treatment	Rate kg(ai)/ha	Wild Mustard Control % ground cover	Crop Tolerance (0-9)
Weedy	-	18	9
Weeded	-	0	9
EL 107	0.075	11	9
EL 107	0.100	8	9
EL 107	0.125	2	9
EL 107 + Trifluralin	0.125+1.4	4	9
EL 107 + Ethalfluralin	0.125+1.4	6	9
Trifluralin	1.4	26	9
Ethalfluralin	1.4	28	9

* Treated October 16, 1984; planted May 10, 1985.

Table 5. EL 107 PPI-S on Sunflowers*, 1985.

Treatment	Rates (ai)	Wild Mustard Control	Crop Tolerance	Crop Yield
		(% ground cover)	(0-9)	g/m^2
Weedy	-	27	9	94 c
Weeded	-	0	9	171 a
EL 107	0.075	14	9	154 ab
EL 107	0.100	4	8	162 ab
EL 107	0.125	1	8	158 ab
EL 107 + Trifluralin	0.075 + 1.1	17	9	154 ab
EL 107 + Trifluralin	0.125 + 1.1	4	8	139 b
EL 107 + Ethalfluralin	0.075 + 1.1	10	8	156 ab
EL 107 + Ethalfluralin	0.125 + 1.1	3	7	165 ab

Seeded May 10; PPI - May 9

Table 6. AC 222293 on Sunflowers*.

	Weed Control**					Sunflower Yields	
	% Ground Cover						
	WM		WO	GF	LQ		
Treatment (kg/ha)	1984	1985	1985	1985	1984	1984	1985
						--- g/m^2 ---	
Weedy	36	13	45	2	6	70	85
Weeded	0	0	1	0	0	183	153
AC 222293 (0.25)	6	0	9	14	9	189	136
AC 222293 (0.50)	1	0	7	16	10	186	132

* Planted May 10; sprayed June 5 (4-leaf stage)
** WM = Wild mustard, WO = Wild oats, GF = Green foxtail, LQ = Lamb's-quarters

YIELD POTENTIAL AND N REQUIREMENTS OF SEMI-DWARF WHEAT VERSUS CONVENTIONAL VARIETIES OF WHEAT

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1985 was the first year in a three-year experiment to determine the effects of a wide range of soil-climate conditions in Manitoba on the N fertilizer responsiveness and yield stability of traditional and new cultivars of wheat, including U.S. semi-dwarfs.

Materials and Methods

The three sites used for the 1985 experiments were selected to represent a cross-section of western Manitoba's soil and climatic conditions. Initial nitrogen (N) fertility at each of the sites was low. The site and soils information is listed in Table 1.

Table 1. Site and soils information for ERDA wheat project, nitrogen response experiment (soils sampled in April, 1985)

Location	Miami (NW 14-5-6 W1)	Minnedosa (NE 23-14-18 W1)	Souris (NW 18-7-21 W1)
Previous crop	corn	barley	wheat
Date sown	May 22	May 24	May 17
Date harvested	October 19	October 22	Sept. 13
Soil type and Texture	Altona V.F. Sandy Loam	Newdale Clay	Souris Silty Clay Loam
pH(1:1 soil:water)	7.7	7.9	7.4
Salinity(mS/mm)	0.2	0.4	0.2
Nitrate-N (kg N/ha to 60cm)	26 (L)*	22 (L-)	23 (L)
NaHCO3-P (kg P/ha to 150cm)	39 (H)	19 (L)	23 (L)
EXCH-K (kg K/ha to 150cm)	398 (VH-)	732 (VH+)	481 (VH+)
Sulphate-S (kg S/ha to 60cm)	72 (VH+)	63 (VH)	18 (L)
Fertilizer applied (kg/ha) 11-52-0 banded with seed	40	70	70
Sulfur broadcast as gypsum	0	0	0

* Manitoba Provincial Soil Test Lab. fertility ratings: L = low, M = medium, H = high, VH = very high.

The experiment at each of the above sites was conducted as a split-plot design with 4 replicates. Main plot treatments were 6 cultivars(cv) of wheat (the U.S. semi-dwarfs Solar, Marshall and Len, the Canadian semi-dwarf HY320, the hard red spring cv Katepwa and the utility cv Glenlea). Sub-plot treatments were 7 rates of N fertilizer from 0 to 240 kg N/ha in 40 kg N/ha increments applied in a band between wheat rows at seeding as urea (46-0-0). Each sub-plot consisted of 9 rows with 20 cm row spacing x 13 m long. Seeding and fertilizer application were done simultaneously with a fertilizer-placement plot seeder, the sole exception being sulfur at Souris which was broadcast as gypsum and harrow incorporated prior to seeding.

The data collected from each plot included: dry matter accumulation at the early post-anthesis stage of Katepwa, dry matter yield at maturity, grain yield and harvest index. Mid-season soil sampling was performed to determine moisture useage and available N. Daily precipitation was recorded at each site.

Results and Discussion

Grain yield. a) At the Minnedosa and Souris sites there were consistent yield increases with increasing N fertilization up to a level of approximately 120 kg N/ha (Tables 2 and 3). Yield levels at 0 kg N/ha were low, reflecting the initial N fertility. The responses to N at these sites followed classic textbook patterns, ie. linear increments in yield with increased N to a maximum point after which yields remained constant. At rates of 40 kg N/ha and greater the Canadian semi-dwarf cv HY320 had the highest grain yields. Len, Katepwa and Glenlea had lesser responses to N fertilization and were lower yielding than HY320 at rates above 40 kg N/ha. The U.S. semi-dwarf cultivars Marshall and Solar were intermediate in N response and yield, being lower than HY320 but higher than Len, Katepwa and Glenlea.

Table 2. Grain yield response of spring wheat cultivars to nitrogen fertilizer in 1985 at Minnedosa, Manitoba

CULTIVAR	KATEPWA	GLENLEA	HY320	LEN	MARSHALL	SOLAR
N APPLIED kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha
0	1419	1601	1740	1466	1374	1781
40	2420	2226	2588	2293	2334	2358
80	2966	2777	3710	2804	3292	3428
120	3244	3094	4619	3036	3822	3888
160	3055	3134	4760	3360	4026	3875
200	3368	3004	4770	3219	4106	3988
240	3181	3102	4804	3167	4243	3894

Std. error = 73 kg/ha

Table 3. Grain yield response of spring wheat cultivars to nitrogen fertilizer in 1985 at Souris, Manitoba

CULTIVAR	KATEPWA	GLENLEA	HY320	LEN	MARSHALL	SOLAR
N APPLIED kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha
0	1375	1636	1628	1227	1270	1567
40	1955	2081	2658	2166	2179	2342
80	2453	2915	3812	2243	3069	3212
120	2651	3108	4190	2718	3456	3567
160	2314	2801	4485	2056	3633	3277
200	2841	3011	4437	2287	3438	3885
240	2033	2773	4552	2189	3520	3637

Std. error = 83 kg/ha

Table 4. Grain yield response of spring wheat cultivars to nitrogen fertilizer in 1985 at Miami, Manitoba

CULTIVAR	KATEPWA	GLENLEA	HY320	LEN	MARSHALL	SOLAR
N APPLIED kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha	YIELD kg/ha
0	1926	1882	2874	2122	2360	1980
40	2026	2411	3022	2413	2940	2734
80	3045	2729	3487	2483	3427	2801
120	2943	3139	3262	2592	3281	3055
160	3171	3071	3681	2624	3467	3354
200	3183	2988	3270	2403	3640	3132
240	2840	3032	3395	2307	3364	3271

Std. error = 45 kg/ha

b) At the Miami site (Table 4) yield levels at 0 kg N/ha were higher at the other sites. However, the yield increments due to increasing N were much smaller than at Minnedosa or Souris. At N levels above 40 kg N/ha HY320 and Marshall had the highest yields. Katepwa and Glenlea performed comparatively better than at the other sites with yields similar to the semi-dwarf cv Solar. Len was inferior, having no yield response at N rates above 40 kg/ha. The generally poor response to N at Miami indicates that factors other than N fertility were limiting yield. The poor yield and N response of the cv Len at this site was probably due to an observed severe infestation of tan spot (Pyrenophora tristochoma) which was apparent during the growing season. The comparatively poor yields of the semi-dwarf cultivars at this site may be a result of greater susceptibility to this disease. However, the exact causes of the poor yield performance at Miami is not readily apparent.

Summary and Conclusions

The results of these experiments confirm that some well-adapted semi-dwarf wheat cultivars have the ability to outyield our traditional hard red spring wheat cultivars under favorable growing conditions in Manitoba. These well-adapted semi-dwarf cultivars also have greater increases due to nitrogen fertilization than traditional hard red spring wheat cultivars.

In the favorable growing conditions in western Manitoba during 1985 the Canadian semi-dwarf cv HY320 consistently outyielded the hard red spring cv Katepwa, the utility cv Glenlea and the U.S. semi-dwarf cultivars Len and Solar. HY320 had superior yield to the U.S. semi-dwarf cv Marshall at 2 of the 3 sites. At the third site, where yield and yield response to N were low, HY320 was equal in grain yield to Marshall.

STRAIGHT COMBINING

Our experience with straight combining dates back to 1982 when we installed an automatic grain dryer and grain handling system and purchased a straight cut header. In the first year we straight combined some rye and some wheat and have progressed to the point that we straight cut everything but canola.

We have found that there are some very significant advantages to straight cutting over the conventional methods. Some of these advantages are:

1. Earlier harvesting with a possibility of improved grades. Grain doesn't deteriorate as much standing as in a swath. Even if the weather is bad, a couple hours of sun gets you going again. Grain in a swath doesn't dry as fast and it could be days before combining can proceed again after a rain.
2. Lower harvesting cost by eliminating swathing.

If we can save an operation, we feel that we can well afford to spend a bit of money on propane if we have to. In 1984, we spent $2.50/ha on propane for the acres straight combined. We couldn't even think of swathing for that price. Furthermore, the dryer doesn't need an operator. Even in 1985, our propane cost was only approx. $10/ha. Even if we had swathed everything we would still have had much the same cost of drying. By straight combining we can eliminate one swather as well as part of a combine. We also save on the labor needed to operate these machines. If we can get the job done with $50,000 less invested in machinery, this is an automatic saving of $10,000/year plus labor and fuel. A total saving for our farm of $15,000 would not be unrealistic.

3. Increased combine capacity because you are not cutting the straw as short.
4. More grain in the bin due to eliminating cutter bar and pickup loss associated with swathing and picking it up again.
5. Can begin sooner in the morning.

Where there are advantages there also have to be disadvantages. Some of these are:

1. More damage from high winds or hail if grain is standing as compared to being swath.
2. Must be prepared to either natural air-dry or hot air-dry part of your production.
3. Since you are doing two jobs at once, combine operator must be experienced and be able to handle the extra strain.
4. Straw will get tough sooner than in a swath. You usually have to quit earlier at night than if you were in swaths.

5. Varieties grown should be resistant to shattering and have strong straw.

These are the advantages and disadvantages based on our experience. I am convinced that for our operation, it is a practice that has definitely increased our net income due to lower harvesting cost and increased grain harvested of a better grade.

Greg Gaudet

BACKGROUND ON INTENSIVE CROP MANAGEMENT

Elmer H. Stobbe
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EUROPEAN EXPERIENCE

The intensive crop management (ICM) system currently used by farmers in western Europe has been developed over the past 25 years. In winter wheat, the first step toward obtaining higher yields was the introduction of the growth regular Cycocel in the mid 1960's. The use of the growth regulator allowed the farmer to apply high rates of nitrogen to his crop without fear of the crop lodging. The second breakthrough in developing higher yields was the development of fungicides to control foot diseases in the early 1970's, and leaf diseases by the mid 1970's. The final step in the western Europe ICM package has been the development of high yielding cultivars which respond to high levels of inputs. By carefully optimizing all the inputs, farmers in western Europe have been able to almost double their yields during the past 25 years.

The question you might ask is why has ICM been so successful in western Europe. I would suggest that the primary reason for the success of ICM in western Europe has been the sustained market for wheat at artificially high prices. The farmer had an incentive to produce more wheat, and using ICM he was able to increase his profitability. In fact, the profit margin was so high that fungicides were frequently applied as prophylactic treatments to guard against potential damage caused by diseases. With the lower grain prices in Europe during the past year, and the continual rise of input costs, the profit margins are down, and farmers are looking to see which inputs can be reduced, or even eliminated.

You will note that I have not said anything about the fact that the farmer in western Europe can count on adequate precipitation every year. Although adequate precipitation is part of the European ICM system, ICM and adequate precipitation are inherently related.

WHAT IS INTENSIVE CROP MANAGEMENT?

ICM is a cropping system where each input is optimized in relation to the optimum use of all other input factors. ICM, therefore, requires multifactor management optimization. Based on climatic and edaphic factors, an ICM system must be tailored to each specific cropping area. ICM is, therefore, a crop production philosphy and not a specific cropping system.

INTENSIVE CROP MANAGEMENT AND THE MANITOBA FARMER

ICM is not new in Manitoba. It began with the introduction of large scale vegetable production in Manitoba. Researchers in vegetable crops have been conducting ICM reasearch for many years.

As I mentioned earlier, ICM is a cropping philosophy, and many of our farmers have already implemented an ICM system on their farm. ICM means attention to details. Every management input must be carefully accessed and applied. As Dr. Efland, a BASF ICM specialist has said, the difference between low and high yields is frequently due to the timing of the inputs.

Can we promote ICM to the Manitoba farmer? With the high fixed costs, high input costs and low grain prices, farmers are facing a cost/price squeeze. By increasing the grain yield without substantially increasing the cost of production, grain production can be more profitable.

Our best success with intensive cereal management in Manitoba has been in winter wheat production. This success has been related to winter wheat's long growing season, and the fact that the early maturing crop is not as subject to drought stress. Large gains can also be made with spring seeded crops grown under intensive management.

How should we promote intensive crop management? We must promote the optimization of all farming inputs over which the farmer has control, many of which have no, or little additional costs. Some of these inputs will be:

1. Use of high quality seed of the best cultivars
2. Seed treatment
3. Adequate seeding rate based on seed viability and size
4. Good seed bed preparation
5. Good seedling technology - uniform shallow seeding
6. Effective use of fertilizer based on soil test and cultivar response
7. Knowledgeable, effective weed control
8. Harvesting at the correct time with optimum combine adjustments for each crop and each cultivar
9. Properly drying and storing the crop

Above all, every operation must be conducted at the optimum time.

As you will note, none of the above inputs require substantial extra funds, just better management of the inputs.

In areas with adequate moisture, and in years with adequate moisture (1 every 2 - 3 years) there may be some benefit to the use of plant growth regulators and fungicides. Currently there are no fungicides registered for leaf diseases in cereals. Although the plant growth regulator Cerone is registered for some barley cultivars, more research is required to determine under which conditions Cerone can be most profitably be used.

RESEARCH REQUIREMENTS FOR INTENSIVE CROP PRODUCTION

ICM require multifactor management optimization. Research in ICM requires multifactor comparisons.

1. Cultivar evaluation.

Culivars must be evaluated at several nitrogen levels, several plants densities (plants/m^2, several seeding dates, and if they are susceptible to leaf diseases, to fungicides. For tall growing cultivars it may be important to evaluate the use of plant growth regulators.

2. Fertilizer evaluation

As you will note from the evaluation of cultivars, fertilizer recommendations must be cultivar specific. Fertilizer optimization will vary with cultivars, and specific recommendations must be made for each cultivar, in conjunction with the seeding density and seeding date. In addition, farmers who intensively manage their fertilizer inputs must have the opportunity to make management decisions after the crop has emerged. Accordingly, research is required to determine the rate of fertilizer to be applied at seeding, and the rate to be applied at the onset of tillering and head emergence. Criteria must be developed to determine the level of these post emergence inputs based on available moisture, crop canopy density and tiller number. Cultivars have been shown to differ in their response to late season applications of nitrogen.

3. Herbicide evaluation

Herbicide recommendations have been developed for the worst senario, high weed pressure and low crop densities. We know that a crop with good seedling vigor and a high seeding rate is an excellent competitor with late emerging weeds, such as green foxtail and red root pigweed. It is, therefore, readily apparent that new herbicide recommendations will have to be developed for use in an ICM program.

4. Fungicide evaluation

Since plant breeders have developed cultivars with excellent disease resistance, little attention has been placed on evaluating fungicides for disease control. Western European studies have shown that when a crop is seeded at the optimum density and using a high nitrogen level, the problem of diseases is accentuated. Cultivars, which at low inputs may not respond to an application of a fungicide may show a dramatic yield response when grown under high input levels.

5. Plant growth regulator (PGR) evaluation

A cereal crop grown under high plant densities, high nitrogen levels, and good disease control can be subject to severe lodging. In western Europe PGR's have been successfully used to reduce the problem of lodging in cereals. In addition, the use of PGR's, in the absence of lodging, can result in grain yield increases, even in semidwarf cultivars.

Todate we do not have sufficient information on the correct rate of application and time to apply PGR's. There are large differences between cultivars in their response to the application of PGR's. The crop response to PGR's will vary depending on environmental conditions, such as temperature and moisture, and the stress under which the plant is growing. More research is required to determine the conditions which will maximize the effectiveness of PGR's.

CONCLUSION

Farmers in Manitoba must incorporate the concepts of intensive crop management if they wish to remain viable under the low grain prices currently being paid. Many of the ICM inputs are relatively inexpensive, and should be adopted by the farmer. More research is required before costly inputs, such as high levels of nitrogen, use of fungicides and growth regulators can be recommended in an ICM system.

ECONOMICS OF INTENSIVE CROP MANAGEMENT

Intensive Crop Management (ICM) is a management philosophy where the objectives are to reduce unit production costs by optimizing production inputs. Crop yields will be optimized with the net effect of increasing profits. Optimizing crop yields is of course quite different from maximizing yields. As farmers we want to maximize yield but only so far as it is economical. We must of course be able to maximize our net profit both in the short term and long term. The successful adoption of ICM to reduce unit cost of production will allow the producer to gain a larger margin between selling a bushel of grain and the costs of growing it, thus leading to higher net profits.

The economic assessment of ICM presented will be based on yields derived from research trials conducted at Minto. As an ideal, ICM can involve examining every aspect of crop production. In ICM we attempt to remove all factors which are limiting the biological yield of the crop. Aspects of crop production which need to be refined include:

1. Tillage practices.
2. Moisture conservation and its efficient use.
3. Proper chemical environment by liming, reducing salinity, etc.
4. Proper crop rotation.
5. Correct amount, kind and placement of fert.
6. Best crop and variety.
7. Proper plant propulation and geometry of stand.
8. Scout for and control yield limiting pests: a) weeds; b) diseases; c) pests.
9. Control of lodging.
10. Correct method and time of planting and harvesting.
11. Timeliness of all operations.
12. Careful records and economic evaluation to ensure maximum economic yields are being achieved.

In the agronomic side of our evaluation, it will not be too surprising to note that we are far from optimizing each of the listed components nor do we know the cost benefits for optimizing each of those components. What we do have is an agronomic and economic evaluation of packages of added input which we call the ICM package as well as studies which attempt to determine the relative importance of each of those added inputs within the ICM framework.

The ICM package which was evaluated consisted of the addition of:

1. foliar fungicides.
2. a plant growth regulator.
3. higher nitrogen rates with split application timings.
4. higher seeding rates.

Trials were conducted with winter wheat, semi-dwarf spring wheat and tall conventional spring wheat cultivars.

The effect of management on the yield and net profit of nine winter wheats are shown in Table 1. The nine cultivars were grown under 2 stubble heights, 7.5 cm or 37 cm. All cultivars survived when given the extra snow protection of the 37 cm stubble. However when grown on the short stubble, Monopol, Absolvent, Vuka, Hawk and Centurk 78 were 100% winter killed, Norwin 90%, Agassiz and Roughrider 70% and Norstar 50%. Only the results from the 37 cm stubble were used in Table 1. No visual difference in winter kill were noted with any cultivar on the 37 cm stubble. Yield increases with ICM on winter wheats ranged from 26 to 72%.

The net profit advantage with ICM ranged from $-70/ha to $160/ha. There are a number of factors which would help to explain the large differences.

1. Cultivars have inherit differences in their ability to respond to the extra input levels with ICM.
2. The ICM package which was used had been developed over the last 3 years for Norstar and may not be suitable for the other cultivars.
3. Plant stands and heads/m^2 for Monopol, Absolvent and Vuka were approximately 1/2 that of other cultivars (450 heads/m^2 compared to 950/m^2). Although each cultivar was seeded at the same kg/ha seed rate the large seed of these cultivars effectively reduced the actual plants/m^2 obtained. Also these cultivars tend to have a lower tillering potential. Thus the standard management practices which include seeding rate may not have been optimum for all cultivars, thereby reducing their yield potential.
4. Semi-dwarf cultivars may not require or respond to the plant growth regulator in the same way as Norstar.

TABLE 1. Effect of Management on Yield and Net Profit of 9 Winter Wheat Cultivars. Minto 1985.

Cultivar/Origin	Conv. kg/ha	Net Profit $/ha	ICM kg/ha	Net Profit $/ha	% Increase Yield	Net Over Conv.
Norstar/Alberta	4125	171	6751	330	63	159
Agassiz/N.Dak.	3730	125	6400	285	72	160
Roughrider/N.D.	3804	130	4773	74	25	-56
Monopol/German	3090	75	5043	109	63	34
Absolvent/German	4117	170	5350	147	30	-21
Vuka/German	3242	56	4100	-74	26	-70
Norwin/Montana	4018	157	5131	120	28	-37
Hawk/Kansas	3240	56	5402	155	67	99
Centurk 78/Neb.	4083	166	5978	230	46	64

Assumptions:

1. Winter wheat $130/tonne

2.	Variable cost/ha	Fixed cost/ha	Total cost/ha
Conv.	170	195	365
ICM	336	211	547

Additional cost of ICM: N fert. $69/ha; Fung. $42/ha; PGR $42/ha; fuel $2.50/ha Machine op. $1.25/ha; interest on op. $9.6/ha; labour & Management $9.90/ha; storage $2.50/ha.

The results of fungicide trials conducted on Norstar from 1983-85 are shown in Table 2. The application of fungicides often resulted in positive net profits. However in situations where disease levels were low or non-existant such as at Russell in 1984 the application of fungicides reduced net profits. The ability of a producer to monitor disease levels and take the appropriate action quickly will determine the long term benefit of applying foliar fungicides.

TABLE 2. Fungicide Economics

	Yield kg/ha Check	Yield kg/ha Fung.	Yield Advant. kg/ha	Added Gross at 13.0 /ha $/ha	Net Aerial $/ha	Net Ground $/ha
1982-83						
Minto	1131	1844	713	93	62	76
MacGregor	2290	2918	628	82	51	65
1983-84						
Minto	3125	3470	344	45	14	28
MacGregor	3576	4060	484	63	32	46
Portage	5177	5388	210	27	-4	10
Russell	3147	2866	-281	-37	-68	-54
1984-85						
Minto	3864	4714	850	110	79	93

The effect of management on the yield and net profit of 8 spring wheat cultivars are shown in Table3. Grain yields were increased from 1 to 22% when comparing ICM to conventional management. However there was a lower net profit when using the intensive management. The net profits of ICM were from $82 to $180/ha less than the net profits of the same cultivars using conventional management. Thus the conventionally managed plots gave a better return with a lower risk. To obtain a better appreciation for negative results obtained by using ICM on this trial, each of the major ICM components were examined in various trials on HY320. The results are presented in Table 4. The response of HY320 to fungicides, nitrogen and seeding density were found to be positive. However HY320 gave a negative response to the plant growth regulator in terms of both yield and economics. The PGR used in this case lowered yields and added to the cost of production. Leaving the PGR out of the ICM package would have resulted in a more positive net profit for HY320. Trials conducted to examine the effects of ten PGR combinations on HY320 failed to show any net gain in 1985. A similar trial conducted with Columbus showed that at least 2 of the 10 PGR treatments helped control lodging and enhanced grain yields. The application of PGR's will have to be cultivar specific and location specific to achieve the maximum benefit.

TABLE 3. Effect of Management on Yield and Net Profit of 8 Spring Wheat Cultivars. Minto 1985.

Cultivar/type	Conv. kg/ha	Net Profit $/ha	ICM kg/ha	Net Profit $/ha	% Increase Yield	Net Over Conv. $/ha
HY320/3M	6169	297	7073	214	15	-82
Marshall/HRS	5788	252	6662	166	15	-86
Oslo/HRS	5262	190	5692	53	8	-137
Fielder/SWS	4546	107	5537	35	22	-72
Glenlea/Util.	4337	82	4396	-97	1	-180
Katepwa/HRS	4352	184	5005	87	15	-96
Columbus/HRS	4570	216	4809	60	5	-156
Neepawa/HRS	4042	141	4576	28	13	-113

Assumptions:

1. Wheat Prices

Semi dwarf HRS	#2	117/tonne
Semi dwarf SWS	#2	117/tonne
Utility	#2	117/tonne
Tall CWB HRS	#2	140/tonne

2.

	Variable cost/ha	Fixed cost/ha	Total cost/ha
Conv.	230	195	425
ICM	405	208	613

Additional costs of ICM: seed $9/ha; N fert. $69/ha; fung. $42/ha; PGR $42/ha; Fuel $2.50/ha; Machine op. $1.25/ha; Interest on op $9.90/ha; labour & mgt. $9.90/ha; storage $2.50/ha.

TABLE 4. ICM Component Analysis - HY320, Minto 1985

	Fungicides				
	ICM w/o fung. & PGR		ICM w/fung, w/o PGR		Difference in Net Profit $/ha
	Yield kg/ha	Net Profit $/ha	Yield kg/ha	Net Profit $/ha	
Fung.A	6073	216	6584	234	18
	PGR (Plant Growth Regulator)				
	ICM w/o PGR		ICM w/PGR		
	Yield	Net Profit	Yield	Net Profit	
Trial 1	7541	311	7354	247	-63
Trial 2	6456	184	5858	72	-112
	Nitrogen				
	ICM w/60 kgN/ha(1 appl)		ICM w/160 kgN/ha(split 3X)		
	Yield	Net Profit	Yield	Net Profit	
w/PGR	5955	153	7354	247	94
w/oPGR	5777	174	7541	311	137
	Seeding Density				
	ICM at 300 seeds/m^2		ICM with 500 seeds/m^2		
	Yield	Net Profit	Yield	Net Profit	
	6328	184	6589	200	16

SUMMARY

1. The ICM package tested was shown to have increased net profit on some cultivars of winter wheat.

2. The ICM package tested was not the optimum one for spring wheats, however the use of extra N and fungicides produced positive net profits.

3. The extra labour and management involved in scouting for pests and application for more crop input will limit the number of acres which could be intensively managed, especially by one man operations.

4. The high input costs imply a greater dependance on high yields. The risks associated with ICM may limit the number of farmers using this type of management +/or the number of acres which can be managed intensively on an individual farm.

5. The adoption of ICM will be strongly influenced by grain prices and delivery opportunities. Getting higher yields to store more would not likely be profitable.

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UPDATE ON JERUSALEM ARTICHOKE

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This update will skip over many specifics which have been developed by several workers in the past decade. More detailed information plus additional references are provided in the 1982 Proceedings of the Agronomists Conference.

In the past decade or so, it has been acknowledged that the Jerusalem Artichoke (J.A.) possesses several interesting characteristics and its products can be used in several ways. The plant survives well under prairie conditions, it has high yielding capability of both underground tubers and above ground foliage.

Major potential uses include production of energy (alcohol), inulin from which fructose, the liquid sweetner can be hydrolized, flour for preparation of low calorie foods and forage for livestock feed. There are also a number of by-products which may have some potential.

As we focus more closely on the "Update" portion of the subject, the following comments reflect current or recent activity.

At Agriculture Canada's Research Station at Morden, several activities are underway.

A small breeding project is underway in an attempt to develop improved tuber shape and a thicker skin on high yielding cultivars. You may recall that there are two named varieties, Columbia released in 1982 and Challenger in 1985. Detailed notes are provided in the Canadian Journal of Plant Science (62: 537-539; 65: 803-805).

Two aspects of herbicide work are underway. First, an evaluation of herbicides to control volunteer growth in other crops is being carried out at Morden. Here a combination of pre-emergent non-selective and decamba type materials shows some promise.

Second, control of weeds in J.A. as a crop has been evaluated from 1983 to 1985. Several pre-plant incorporated herbicides show promise in these research plots. Currently, there are no registered materials for either volunteer or in-crop weed control.

Procedures for dehydration of sliced tubers and further processing to make a low calorie flour have been developed by Dr. Joe Mazza at Morden.

Finally, a system has been developed for economical long term storage of tubers, using a liquid media. The storage takes place at outside temperatures, summer and winter. Tubers stored in this manner are suited to use in processing systems only. The process is protected by a licensing system involving Agriculture Canada.

The Food Science Department, University of Manitoba has also carried out a series of developmental studies. Currently, a candidate in the Department working towards a PhD degree expects to complete work in 1986. This will conclude studies which have developed a system to extract inulin and convert it to liquid sweetners as well as identify and quantify numerous chemical components. Attempts to obtain funding to take these developments beyond the small scale or laboratory bench stage have not been successful. Further development awaits commercial input or institutional funding.

This past season, a small group known as the Artichoke Growers of Pembina Inc. encouraged local farmers to plant small acreages of J.A. The group, through contracts arranged for research and development input, sale of seed and various other aspects of crop production. It is understood that participation was obtained from 42 farmers and that 64 hectares were planted. As part of this activity, the farmers were encouraged to use the foliage as livestock feed. Information provided to the participants at public meetings suggested that experiences in other areas, particularly Nebraska had shown that J.A. was used in a multi-cut production system of quality forage production.

After discussions within Manitoba Agriculture it was decided to submit forage samples to the local feed testing laboratory from several locations in Manitoba and to do this from early July to October. During this period, regrowth was to be observed as well as the effect of top removal on tuber yield at a stage of plant development which would be similar to the harvest of alfalfa. Twenty-seven forage samples of the variety Columbia were submitted from June 28 to October 18th. They were collected from spring planted locations at the Brett-Young seed facilities (near Winnipeg), St. Claude, and Beausejour. A first year volunteer stand at Rosa was also sampled. The above range of date locations and production histories resulted in values from the feed laboratory which fluctuated significantly. T.D.N., crude fiber and acid detergent fiber values ranged from higher quality straw to top alfalfa. Protein values ranged from levels comparable to alfalfa to quite low values, particularly as the foliage matured. Laboratory analysis levels of phosphorus and calcium were higher than expected. Twenty-one out of 27 values for phosphorous were above 0.25%, a top level for alfalfa and 25 out of 27 levels of calcium were above 1%, a level higher than most grass mixtures used as fodder. (See Figures 1 and 2).

One of the surprising observations in the field at Rosa concerned regrowth. A multi-cut forage system requires rapid regrowth but at the Rosa location, which was under moisture stress in July, regrowth was minimal. At that location, one cut of forage at a desirable stage of plant development would have been superior to a multi-cut process.

Figure 1

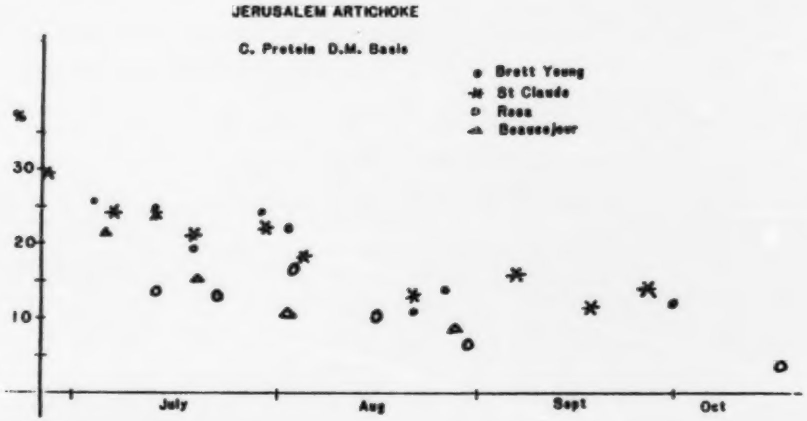
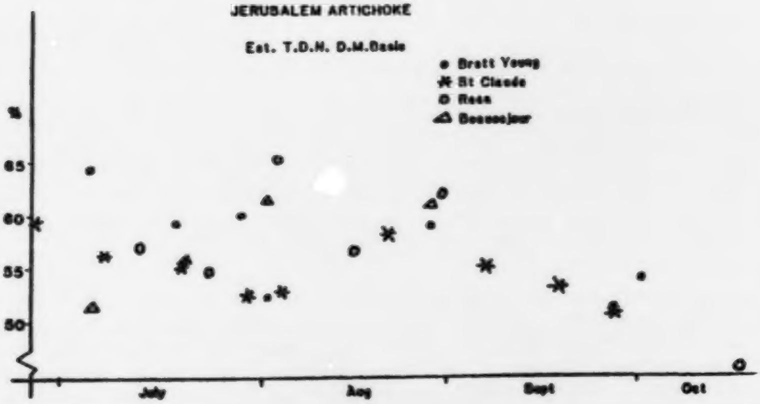


Figure 2



There have also been suggestions that quality forage can be produced as well as a high yield of tubers. However, this is contrary to normal expectations. At Rosa this year, removal of tops on July 22nd on a 10 meter strip was followed by harvest of tubers October 18th. A comparable area in the same row where tops remained was also harvested October 18th. The effect of the top removal was a 77% reduction in yield. In addition, tuber size was markedly reduced and mechanical harvest of the majority of these tubers would be difficult. It will be interesting however to observe if these small tubers will be sufficient to provide a base for a strong volunteer crop in 1986.

From this update, what can be summarized:

1. Jerusalem Artichoke is a vigorous highly productive plant.
2. Research and development projects to date show that there are a number of potential uses for both foliage and tubers.
3. The only outlet currently for plant parts easily accessable to farmers in Manitoba is as a livestock feed. Other uses continue in the "evaluation opportunity" stage with no concrete plans announced.
4. Information on feeding value, handling systems and preservation techniques to utilize foliage or tubers as a significant livestock feed needs further evaluation.
5. Current agronomic information available contains gaps which would be significant if the crop is commercially grown.

MANITOBA GREENHOUSE INDUSTRY

CHANGES AND CHALLENGES

In addressing the topic "Greenhouse Industry in Manitoba - Changes and Challenges", I would like to key in on the following points;

Manitoba's Greenhouse Industry - Brief Profile, what has happened to the industry in terms of growth and adoption of new technology over the past 10 years, what has happened to the industry throughout North America (a benchmark for Manitoba) and what are Manitoba's opportunities.

Manitoba's Greenhouse Industry - A Brief Profile

Manitoba's Greenhouse Industry is made up of approximately 150 growers with 6 ha of plastic cover. The industry produces 5.5 million dollars in floriculture product. The majority of the industry is comprised of bedding plant growers with average production areas of 1,000 to 1400 m^2. The season of operation is generally February to July and these production units are mainly run by family labor.

Approximately 40% of the greenhouse production area in Manitoba is year-round production of seasonal pot plants such as mums, poinsettias and lilies. Average production sizes range from 2800 to 5000 m^2.

The major economic concerns of the industry include;

Labor costs (35% of the operating costs), plant material costs (41% of the operating costs) and heating costs (12% of the operating costs).

What Has Happened to The Industry in Terms of Growth and Adoption of New Technology Over the Past 10 Years

The industry gross sales have increased over the past 10 years but the production area has declined. The industry has shifted from glass covered facilities to plastic coverings and from oil to gas heating.

Manitoba's share of a growing Canadian industry both in terms of growing space and total sales has not changed significantly over the past 10 years (1.6%). The Canadian greenhouse industry on the otherhand has grown at a rate of 10% per annum over the past 5 years. It is interesting to note that during the last 2 Canadian recessions (30's and 80's) the greenhouse industry was one of the few agricultural sectors to show a positive growth and it is also one of the few agricultural commodities expected to continue to grow over the next few years.

What Has Happened to The Industry Throughout North America (A Benchmark for Manitoba)

The greenhouse industry represents one of the most intensive forms of agricultural production found anywhere in the world. With this distinction goes the high labor and capital inputs these operations require. For example, capital input costs range from $160.00 to $115.00 per m^2 of production area. Labor costs of $5.00 to $6.00 an hour in North America must compete with $3.00 per day in Columbia for cut flower production.

The greenhouse industry has remained dormant in terms of production facility changes until the mid 70's. However, over the past 10 years dynamic changes have taken place in a relatively short period of time. Dramatic changes have occurred that have been attributed largely to the energy crunch of the mid 70's. Heating innovations such as zonal root heating and infra-red heating systems place the heat where it is needed for plant growth rather than heating the air environment of the plant. The use of night curtains range from simple addition of an extra layer of plastic to the structure, to poly styrene pellets blown between 2 layers of plastic at night and retrieved in storage bins during the day.

Climate control has increased with more accurate precisely positioned sensors and with the use of computers to coordinate the control of various environmental factors such as carbon dioxide levels, humidity, temperature, shading and ventilation. A recent dutch study has demonstrated that a 1ºC of over heating raises the total fuel cost by 5%.

Efficient space utilization means more plants per m^2 which turns into greater profits per m^2. Better space utilization through the use of rolling benches which has improved growing space from the traditional 65% utilization of total area to the 90% by eliminating the walkways. Double-decking benches and the use of reflective benching materials have improved plant quality and space utilization.

Mechanization has played a major role in streamlining the handling of plant products. This scale of mechanization equipment on the market today has allowed the small grower access to cost cutting measures that were previously available only to the large production ranges. Conveyor belts can move 1500, 15 cm pot mums in less than 10 minutes. In the past this was a 30 to 40 minute job. A large grower with an integrated mechanization system can produce 1 million pot mums with less than 30 people. For example, machines can fill 15 cm pots with soil at the rate of 3500 per hour.

Greenhouse coverings have undergone one of the most dramatic changes. The greenhouse industry still is mainly glass covered (60% of the production area in Canada). However, improvements in radiant energy retention, anti-fogging additives for better light transmission, weathering ability and twin-walling have improved product availability on the market. Crop production cycles have been dramatically reduced and the fine tuning production requirements with carbon dioxide, supplemental lighting and large self-contained transplants have reduced greenhouse production time from 12 weeks for petunias to 8 weeks.

"Plugs" (high density seedling production in small containers), have permitted faster transplanting compared to bareroot seedlings. Studies have shown 2 to 3 times the production with plugs combined with conveyor systems. For example, the labor costs for transplanting a 72 seedling flat of bedding plants have been reduced from .50¢ per flat to .11¢ per flat (assuming a $4.00 per hour rate of pay).

The use of soilless mixes (peat moss, vermicultie), has helped reduce disease problems and improve uniformity of plant product.

Cool grown crops are being selected and improved on as a means of reducing the energy cost per plant.

Greenhouse lighting has made large improvements in its technology for economical light supplementation both in the greenhouse and growth room applications for seedling production.

Markets for floricultural products are increasing at an accelerated rate. Housing units have become smaller, uniform in design and higher in density. Gardening, landscaping and houseplants have become fashionable as an expression of consumer uniqueness in an environment of uniform living accommodations. Quality of product is a dominating marketing trend of our time. However, consumers want quality at less than the top grade prices. Chain marketing of floral products continues to grow and is projected to capture a larger portion of the market as well as expand the per capital spending on floricultural products. The Canadian per capita consumption of $12.00 per person lags far behind the Dutch figure of $62.00 per capita for floricultural purchases. Quality, selection and low price (less than $5.00) per purchase will be the keys to duplication of the European trend of consumer spending on floricultural products for the North American consumer.

Improved research in floricultural storage has increased shelf-life of many floricultural products both in the stores and in the home. This lower perishability factor has allowed lower prices for these commodities and in turn has increased the total floriculture sales.

What are Manitoba's Opportunities

Manitoba's greenhouse industry's static growth, (see Table 1) could be expanded 4 to 5 times its existing size in terms of dollar generated if the following challenges could be met. These include;

. Developing a system to coordinate the markets of existing small producers, so that supply levels required by the large retailers could be met.

. Change grower production practices from multi-crops to specialization of a few crops. This would improve on quality of product and efficiency of production. Marketing development programs, are required to alter consumer awareness and to identify the freshness of the local floricultural product versus the imported floricultural products. The demonstration of new greenhouse technology is required to maintain local grower competitiveness. The focus of this demonstration could be directed to major cost factors such as heating, labor, plant material and markets. The greenhouse industry in Manitoba does not have a local research program to service the industry's unique needs and there is little government support for the industry. An attitude change is required by government and research institutions in recognizing that the greenhouse industry can be a strong contributor to Manitoba's agricultural diversity.

TABLE I

GREENHOUSE INDUSTRY ($) VALUE

Year	Canada	Manitoba	% Market
1955	12.4 million	120,000	1.0%
1980	106.0 million	3.5 million	2.8%
1985	330.0 million	5.5 million	1.6%

Manitoba's greenhouse resource factors of high natural sunlight levels (2200 hours of bright sunshine), relatively inexpensive hydro (.3¢ per kilowatt hour), competitive heat costs ($12.50 per m^2 per year) and its central geographical location make it an attractive agricultural industry to develop. This potential can be translated into a 25 to 30 million dollar industry (farm gate value) in the next 5 years. The farm gate value potential can be increased a further five fold when spinoff industries are considered. The key, therefore, to developing Manitoba's greenhouse industry is the allocation of development dollars and human resources before floriculture imports dominate our market.

WEATHER AND THE FARMER: Playing the Odds to Reduce the Risk

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1. Introduction

It is self-evident that on-farm activities and crop conditions depend on the present weather and the growing-season's weather to date and that the suitability of a crop for a particular region depends on the climate. Not so obvious, is that farm weather forecasts are useful to farmers.

Decision-makers, including many farmers, tend to demand perfect forecasts and choose not to use information which may be inaccurate. Forecasts are fallible judgments. They do, nevertheless, specify the conditions which have the greatest likelihood of occurring. That is, they provide odds which can be used in the decision-making process.

A further impediment which limits the use of weather forecasts is the large size of most Prairie farms. Unlike an orchardist, market gardener or livestock producer a grain farmer's large operation limits his capacity to react to forecasts of adverse conditions. For example, even if a grain farmer is warned of an impending frost, he can not use this information to minimize his losses as there is no practical action that can be taken to protect the large number of acres at risk.

Pay-offs from the use of weather forecasts arise from incorporating the probability of occurrence of relevant weather events in the on-farm decision making process (Thompson 1972); that is, in playing the odds to reduce the amount of risk.

The purpose of this paper, therefore, is to illustrate the utility of weather forecasts to farmers. Section 2 briefly describes recent changes to the farm weather forecast program in Manitoba. Some illustrative scenarios are given in Section 3 while Section 4 contains the conclusions.

2. Farm Weather Services/Information for Farmers

Agrometeorological forecasts differ from the standard public forecasts in that the list of forecast elements is expanded to include parameters of specific interest to farmers. That is, in addition to prognostications of sky conditions, precipitation probabilities, maximum and minimum temperatures and winds, these forecasts indicate the relative humidities and drying conditions that are anticipated over the next couple of days. Greater detail is also provided on the winds and on how they are expected to vary during the forecast period.

In its continuing effort to provide weather informatiion for farming, a new Rural forecast format was instituted, on a trial basis, by the Atmospheric Environment Service, Central Region in May 1985.

The objective was to increase the flow and timeliness of forecast information to farmers (McDougald, 1985). The Farm Forecast program was amalgamated with the Public Forecast program to produce a single forecast for the rural community. The move took advantage of the established public forecast distribution channels. It increased the number of daily issues of farm forecast information from 2 to 4 and it provided for a more continuous weather-watch with amendments as required. A limited survey of the media and agricultural users conducted this past fall suggested a general acceptance of the new format along with a desire to see it continue (Hunter et al, 1985). A winter trial is now underway and further evaluation will occur next spring.

3. **Illustrative Scenarios: Playing the Odds to Reduce Risk**

The following scenarios simulate the decision making process and demonstrate the utility of "imperfect" weather forecasts in two selected situations. Undoubtedly, this process is already happening on the farm, at least, at the intuitive level.

3.1 Herbicide Application

Let's assume that a herbicide application is required, that this particular formulation must remain on the weeds 12-14 hours to be effective and that the herbicide costs $15.00 per acre.

If the forecast reads:

Today - Sunny, etc.
Tonight - 80% Probability of Thundershowers, etc.

should the herbicide be applied?

There are two courses of action open to the farmer:

(1) Spray today - If it rains, which the forecast suggests is the most likely event, the herbicide's effectiveness would be reduced and a second application at an additional cost of $15.00 per acre may be required. If it doesn't rain, nothing is lost and the work gets completed so that the farmer can get on with the other jobs at hand.

(2) Don't spray today - If it rains as forecast, an ineffective herbicide application and a costly repeat application are avoided. If it doesn't rain, an ideal spray day may be lost and the farmer may have to wait a considerable time for another suitable day (i.e., warm with light winds).

In deciding whether to spray or not to spray, it may be advantageous for the farmer to pay close attention to the forecast. An 80% probability of thundershowers tonight means that in 10 comparable weather situations it should rain on 8 of those occasions. A further consideration is the accuracy of the forecast. Verification statistics (Sanders, 1963, Beal, 1984 and Ishii, 1985) generally reveal that forecasters have a tendency to over-forecast when probabilities of precipitation (POP's) are greater than 50%. That is, the observed frequencies of precipitation are generally less than the forecast values. The opposite bias is apparent at the lower end of the scale. There is a tendency to under-forecast when low POP's are forecast. What this means is that when the forecast indicates an 80% probability of precipitation, the actual probability of rain is likely closer to 70%. That is, the odds that it will rain are 7 to 3. With this information in hand, a farmer can now make an enlightened decision on whether to spray or not to spray. His course of action is ultimately determined by the risk he's willing to take in this situation.

3.2 Harvesting Damp Wheat

Let's assume that a wheat field has been swathed just before an extended wet period, that the season is rapidly advancing and the grain is still not in the bin.

If the forecast and outlook read:

Today (Day 1) and Tomorrow (Day 2) - Sunny, warm and windy with excellent drying conditions, etc.

Day 3 - Sunny (i.e., no rain), etc.

should the tough to damp wheat be combined over the next two days or should it be left in the field to dry?

There are two courses of action open to the farmer:

(1) Harvest the damp grain on Day 1 and 2 - It doesn't matter whether or not it rains on Day 3, as the wheat will be in the bin by that time. This course of action is not without a cost to the farmer. The grain must be dried if it is to be delivered to the elevator without penalty. Assuming that the farmer owns a grain-drier, the cost of propane alone is 15-25¢ per bushel plus extra handling is required. This cost is often referred to as a precautionary cost.

(2) Leave the swath in the field to dry on Day 1 and 2 - If it is sunny and doesn't rain, as suggested by the outlook, the farmer can harvest on Day 3 and not incur the precautionary grain-drying costs. If the outlook is incorrect, the harvest is further delayed with a potential further reduction in the quality of the grain with reduced returns to the farmer.

In deciding whether or not to leave the wheat in the field to dry it may be advantageous for the farmer to consider the outlook. Unlike the POP forecasts for today and tomorrow, the outlooks for Day 3 are categorical forecasts. Verification scores (Prairie Weather Centre, 1983-1985) suggest that during the growing season "no rain" outlooks are correct about 80% of the time while around 40% of the "rain" outlooks are hits.[1] In this situation, where the outlook indicates no rain the odds are about 8 to 2 that it actually won't rain on Day 3.

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[1] A word of explanation may be required, the chance of it raining on Day 3 is not 50%. Unlike the flip of a coin the two events, rain or no rain, do not have an equal probability of occurring. Due to the Prairie's semi-arid climate, a no rain day is about twice as likely to occur as a day with rain. Therefore, rain outlooks whose percentage correct is greater than 33% show skill.

As in the previous scenario, the farmer is now in a better position to make the required decision.

4. Conclusion

The two scenarios outlined in Section 3 have the following elements in common:

(a) A forecast defines the probability of occurrence of relevant weather events.

(b) In general, there are two potential cost/benefit ratios associated with each available option - one is realized if the weather occurs as forecast while the other applies if events do not occur as forecast.

In each situation, the chosen course of action depends, in the main, on the odds of the relevant weather event occurring and on what risks a particular farmer can or is willing to take. In effect, a weather forecast helps to point-out the path of minimum risk.

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SMALL SCALE MAPS OF WATER EROSION POTENTIAL AND SALINITY FOR MANITOBA*

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Canada-Manitoba Soil Survey

INTRODUCTION

In recent years researchers have begun to evaluate the severity and extent of a variety of soil degradation problems on the prairies. Some of the initial investigations dealt with site specific or small-area soil degradation (DeJong 1982, Shaykewich et al 1984). With the growing concern over the extent and rate of soil degradation, and the lack of data and resources to assess the current severity of the problem, there was a need for broad regional or provincial assessment of the risk or potential for soil degradation.

The objective of this investigation is to compile a series of small scale (1:1 million) maps of soil degradation potential for Agro-Manitoba. The maps are to include a soil salinity extent map, a water erosion potential map under non-vegetated conditions and a water erosion potential map under estimated current land use conditions. These maps will be correlated and combined with similar maps for Saskatchewan and Alberta to produce soil degradation potential maps for the prairie region.

MATERIALS AND METHODS

The Soil Landscapes Map of Manitoba (Canada-Manitoba Soil Survey, unpublished) is used as the map base for designating soil degradation potential. This 1:1 million scale map utilizes standardized symbology and map unit delineations and contains generalized soil and landscape information required for calculating the potential for water erosion and salinity. Similar maps are available for Saskatchewan and Alberta which will facilitate the eventual compilation of prairie region degradation maps.

a) Water Erosion Potential Maps for Agro-Manitoba

Two preliminary water erosion potential maps are being developed using a modified Universal Soil Loss Equation (USLE). The USLE estimates water erosion potential using the equation:

$$A = RKLSCP$$

where, A is the rate of soil loss
R is a rainfall erosivity factor
K is a soil erodibility factor
L is a slope length factor
S is a slope steepness factor
C is a vegetative cover - management factor
P is a supporting conservation practises factor

Rainfall erosivity factors (R) have been calculated for 13 weather stations across southern Manitoba and southeastern Saskatchewan. R-factors were assigned to individual polygons on the landscapes map based on physiographic similarities among polygons (Table 1).

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* Paper presented to Manitoba Agronomist Annual Conference, Dec. 11 and 12, 1985, U of M, Winnipeg.

Table 1. Precipitation Erosivity Factors for Selected Weather Stations (SI units)

Weather Station	Rainfall Erosivity Factor (R)	Snow-melt Erosivity Factor (RS)	Total Precipitation Erosivity Factor(RT)
Brandon (aver.)	914	37	951
Riding Mt.	1257	94	1351
Bissett	700	66	766
Winnipeg (aver.)	1090	44	1134
Duck Mt.	685	81	776
Dauphin	840	47	887
Gimli	953	64	1017
Portage la Prairie	894	38	932
Hudson Bay, Sask.	748	72	820
Indian Bay	1090	86	1176
Melitta	730	32	762
Turtle Mt.	730	78	808
Porcupine Mt.	850	84	934

The R-factors are estimated using two-year, six-hour rainfall data (Ateshian, 1974). A snow-melt factor is added to this equation to account for erosion from spring-melt runoff. Snow-melt was assumed to be the depth of snow on the ground recorded in March converted to water equivalent using snow density data. The modified RT-factor equation is written as:

$$RT = 0.417\ P^{2.17} + PS$$

where, RT is the total annual erosivity factor
P is the 2-yr return interval, 6-hr duration precipitation (mm)
PS is the snow depth on the ground at the last recording date in March converted to water equivalents (mm)

The soil erodibility factors (K) are derived using the soil erodibility nomograph (Wischmeier, 1978). Approximately 500 surface samples from imperfectly and well drained, cultivated soils are grouped into 15 textural classes. The average K-value for each textural class is then calculated and applied to each landscape polygon according to the dominant and significant surface soil texture indicated for the polygon (Table 2).

Slope length (L) and slope steepness (S) measurements, from field observations and estimates based on landscape descriptions included in the landscape map legend, are converted to an LS-coefficient (USDA, 1978) and applied to each polygon.

The erosion potential map illustrating the influence of vegetative cover utilizes four estimated cover-management factors (C) based on analysis of crop district statistics and field observations of current cropping practises (Table 3).

Table 2. Soil Erodibility Factors for Soil Texture Classes

Soil Texture Class	Soil Erodibility Factor (K)	Number of Surface Samples
S	.09	6
FS	.10	49
LS	.12	11
LFS	.16	57
LVFS	.33	8
SL	.17	30
FSL	.16	35
VFSL	.32	24
L	.26	61
SIL	.31	19
SCL	.18	17
CL	.22	57
SICL	.25	24
SIC	.21	43
C	.17	76

Table 3. Crop Rotations and Vegetative Cover Representative of Current Conditions in Agro-Manitoba

Annual Crop Rotation or Vegetative Cover	Cropping Factor (C)
SG-SG-SF-Rc(Lr)	0.43
SG-SG-SG-SF	0.31
Continuous SG	0.19
Forest (75%) + Pasture (25%) (80% ground cover)	0.019

SG = Spring Grain
SF - Summer Fallow
Rc = Row Crops (low residue)

The C-factor coefficients are taken from those developed for North Dakota water erosion investigations (USDA, SCS, 1975). The C-factors are applied to polygons based on physiographic similarities among polygons adjusted by field observations.

A conservation factor (P) has not been applied in the developmental stages of the water erosion potential maps.

b) Map of Salt Affected Soils for Agro-Manitoba

This preliminary map is based on generalized soil survey information converted into a simple presence or absence designation for each landscape polygon. In addition, the map indicates:

1) dominant position of the salts, i.e. surface or subsurface,
2) estimated extent (%) of the polygon affected by salinity,
3) common location or occurrence of the salt affected areas in the polygon, and
4) dominant ionic composition of the soluble salts in the soil.

Consideration is also being given to a fifth component to highlight the hydrologic environment for each polygon although it has not been done at this time.

The map symbol sequence is defined as follows:

S.A.L.T.

where: S - Identifies salinity status according to:

N = Non-saline
av. EC (0-120 cm) <4 dS/m

S = Saline
av. EC (0-60 cm) >4 dS/m

D = Subsurface saline
av. EC (0-60 cm) <4 dS/m
av. EC (60-120 cm) >4 dS/m

A - Identifies area affected by salinity according to % by class:

Class		S	D*
1	=	<1%	-
2	=	1-5%	-
3	=	5-15%	<15%
4	=	15-50%	15-50%
5	=	>50%	>50%

*Note: Broader classes are used for the subsoil designation because of the greater difficulty in identifying and extrapolating this condition.

L - Indicates the most common location or occurrence of salt affected areas in the polygon according to:

d = in or adjacent to depressions (wetlands)
i = irrigated lands
s = sloping lands (seeps)
v = drainageways - (stream channels, creeks, etc.)
(others can be added)

T - Indicates dominant type of salinity (dominant cation and anion)

1 = Mg^{++}, $SO_4^{=}$

2 = Na^{+} , $SO_4^{=}$

3 = Na^{+} , CL^{-}

4 = Ca^{++}, Cl^{-}

(others can be added)

e.g. Symbol

S2d2 - indicates approximately 1 to 5% of polygon is affected by salinity occurring in or near depressional areas. The dominant soluble ions are sodium and sulphate.

The salinity data from soil survey will be supplemented with additional information from other agencies, such as the provincial Water Resources Branch and the Provincial Soil Testing Lab. These data will be combined through cross-section and overlay techniques (e.g. Fig. 1) to produce a final, more comprehensive map of salt affected soil landscapes in Manitoba.

In summary, the development of these small scale maps depicting water erosion potential and soil salinization has relied heavily on the generalization, interpretation and extrapolation of a limited amount of available soil, climate, land use, and landscape information. These maps are provisional at this stage and will be, in all likelihood, revised at least once more before publication. Completion of these maps is planned for early 1986, pending final edit and correlation with Alberta and Saskatchewan. Printing and publication will be done by CanSIS and the Cartographic Section of the Land Resource Research Institute in Ottawa.

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Proposed Revised Manitoba Agronomists' Conference

- S. Banasiak, Manitoba Agriculture

In, at least the past fifteen to twenty years, the Manitoba Agronomists' Conference has served as an information source on new and current research, as well as identifying problems for agronomists, researchers and farmer oriented contact persons.

We have seen the Manitoba Agronomists' Conference change from a field crop recommendations making body, to now, an information centre.

Last year, during the 1984 Manitoba Agronomists' Conference, a resolution was brought forward and adopted which basically called for a Committee to investigate the possibility of expanding the Manitoba Agronomists' Conference to include other disciplines such as Soil Science, Animal Science, etc.

Under the authority of your Chairman, Ed Larter, a Committee was formed which consisted of representatives from all Lead Committees' of the Manitoba Agricultural Services Co-ordinating Committee (MASCC). This Committee met on September 12, 1985 with the following discussions, concerns, and suggestions.

In general, all groups involved indicated a positive approach to the concept of including as many segments as possible in the Conference. Some of the major reasons for adopting the concept were:

a) Agronomists (i.e. Ag Reps) would prefer attending one conference due to travel and time constraints.

b) More communication is required between disciplines which could lead to more support in areas of common concern.

c) Be a one stop informational update which could also include industry displays.

This proposed new Conference format lends itself to be held off campus at a major hotel or convention facility with ample parking. As long as I can remember, we have always had a problem with parking at the University of Manitoba. Hopefully, if this approach is adopted, the Conference would be held in a location which is readily accessible with ample parking space.

Some of the groups who have expressed interest in the revised format are: Soil Science, Animal Science, Crop Science and possibly the Economics group. When looking at these groups, the Crop Science group present papers at this Conference, Animal Science hold their Conference the day before our Conference, and the Soil Science group will be meeting in early January. With the exception of the Crop Science group, the Manitoba Agronomists' Conference, all of the meetings are being held off campus, in a hotel with a registration fee.

A registration fee would have to be charged in order to recover the costs involved, and could provide funds for out-of-province speakers. All of the groups previously mentioned, have a registration fee with the exception of the Manitoba Agronomists' Conference.

The question of timing and organization was certainly raised. The concensus of the Committee was that it be held in the same time frame as the Manitoba Agronomists' Conference. If held earlier, some of the research papers may not be available, and if held later, information of concern would not be available by ag reps, agronomists, etc. for use in rural farm meetings. If this concept is adopted, a natural organizing committee would be the Manitoba Agronomists' Conference Organizing Committee. Individuals elected to this Committee would have to be representatives from the other disciplines involved in the Conference.

Looked at by the Committee was the question of scheduling of papers. This would be the most crucial part of the whole new format. Presently, the Committee is of the opinion that it be a combination of, concurrent and separate sessions. An example would be:

Day I - Soil Science Meeting
- Papers of general interest

Day II - Concurrent Sessions

Soil Meeting	Crop Science Meeting
- Papers for a specific audience	- Papers of general interest

Day III - Concurrent Sessions

Crop Science Meeting	Animal Science Meeting
- Papers of limited interest	- Papers of general interest

Some of the feedback from interested groups indicated things such as:

- No registration fee for students.
- The individual groups not lose their "identity".
- Maybe the name "Manitoba Agronomists' Conference" be changed to "Manitoba Agrologists' Conference" which then would encompass all segments of Agriculture.
- May lead to other groups wanting to participate, i.e. Agriculture Engineering.

In summary, our findings have determined 3 things:

1) That there is support from the various groups for a new conference format.

2) There would be a registration fee associated with the conference.

3) The conference be held off campus.

The questions now arises, do we proceed, or remain as is. I do suggest that this be discussed during the MIA banquet informally. Then, during the business session, a resolution be brought forward and voted upon.